SITE BACKGROUND SUMMARY
AND
DETAILED SCOPE OF WORK

FOUR COUNTY LANDFILL SITE
AUGUST 26, 1992

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FULTON COUNTY, INDIANA

REVISION: 1

AUGUST 26, 1992

PREPARED FOR:

FOUR COUNTY LANDFILL TECHNICAL COMMITTEE

PREPARED BY:

ENVIRONMENTAL RESOURCES MANAGEMENT-NORTH CENTRAL, INC.
102 WILMOT ROAD, SUITE 300
DEERFIELD, ILLINOIS 60015
PROJECT NO. 91302

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EXECUTIVE SUMMARY

This Site Background Summary and Detailed Scope of Work is being submitted to the Indiana Department of Environmental Management (IDEM) by the Four County Landfill Site Participating Respondents, in support of the Good Faith Offer submitted to IDEM on April 27, 1992. This document presents a summary of existing data previously collected at the Four County Landfill Site, including a compilation and evaluation of available information regarding site history, site physical characteristics, waste characteristics, and the nature and extent of contamination. In addition, a detailed Scope of Work (SOW) has been prepared for performing site stabilization, a remedial investigation (RI), and a feasibility study (FS).

The Four County Landfill Site was operated initially as a municipal landfill, and subsequently as an interim status facility as defined by the Resource Conservation and Recovery Act (RCRA). The site was closed by judicial decree in 1989 and is currently being regulated under the Indiana State Cleanup Authority, with guidance from the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Contingency Plan (NCP).

In contrast to many sites that undergo the RI/FS process, a significant volume of data has already been collected at the Four County Landfill Site. For example, over 100 piezometers and ground water monitoring wells have been installed during the various phases of operations. More than 70 of these sampling points were installed during the middle to late 1980s as part of RCRA compliance actions, and are therefore of sufficient quality to use during the RI/FS. The completion of numerous soil borings, monitoring wells, and piezometers has resulted in a detailed understanding of the site-specific geologic and hydrogeologic settings. Although

complete ground water analytical results are not available for many of the monitoring wells and piezometers currently installed on site, this site characterization data gap can be satisfied by sampling a suitable number of representative wells, and by analyzing the collected samples for a consistent set of laboratory parameters. The results of these activities will satisfy the existing data gap regarding the potential extent and magnitude of contamination in the ground water system on site. These data will then be used to determine the need for off-site monitoring wells, and if necessary, the appropriate locations for those wells.

In addition, data obtained during the previous investigations are sufficient to locate and characterize the potential source of contamination and to determine the approximate volume of this source. Previous investigations included a comprehensive characterization of the materials deposited at the site, including the manner in which those materials were disposed. Detailed maps and illustrations have been prepared to show the distribution and characteristics of waste materials deposited at the site.

The draft Statement of Work prepared by IDEM for the Four County Landfill Site identified the following nine tasks to be performed:

- Task 1: Scoping;
- Task 2: Site Stabilization;
- Task 3: Community Relations;
- Task 4: Site Characterization;

- Task 5: Baseline Risk Assessment;
- Task 6: Treatability Studies;
- Task 7: Monthly Reports;
- Task 8: Development and Screening of Remedial Alternatives; and
- Task 9: Detailed Analysis of Remedial Alternatives.

The Participating Respondents will conduct the RI/FS portions of this SOW (Task 1 and Tasks 4 through 9) consistent with the guidance documents and additional requirements specified in the Agreed Order negotiated between the State of Indiana and the Participating Respondents. As described in Section 5.0 of this report, Site Stabilization (Task 2) will be implemented by the Participating Respondents by providing the necessary personnel and contractors for continued operation/maintenance activities. Details concerning Community Relations (Task 3) will be included in the Agreed Order. A brief discussion of the RI/FS portions of the SOW, including cross references to this Site Background Summary and Detailed Scope of Work, is presented below:

Task 1: Scoping

The primary effort during the scoping task will be the preparation of an RI/FS Work Plan, a Sampling and Analysis Plan (SAP) ~~Field Sampling Plan (FSP)~~ that will include a Field Sampling Plan (FSP) ~~Sampling and Analysis Plan (SAP)~~ and a Quality Assurance Project Plan (QAPP),

a Health and Safety Plan (HSP), an Environmental Evaluation Plan, and a schedule for implementation of tasks and deliverables. As described in Section 6.3.2, the environmental evaluation will consist of a separate report to summarize existing, published information pertaining to the Four County Landfill Site.

The Work Plan and supporting plans will be prepared consistent with Section 6.1 of this Site Background Summary and Detailed Scope of Work. In addition, the Work Plan documents will be prepared so that the data collected as part of the RI/FS will be sufficient in quality to allow an evaluation of the potential State and Federal applicable or relevant and appropriate requirements (ARARs). Preliminary ARARs are identified in Section 6.1 of this document.

Task 4: Site Characterization

The site characterization task will proceed in a phased manner based on the results of previous investigations at the site and any preceding tasks. In this manner, each task can be modified as necessary to maximize data quality while progressing toward remediation in a cost-effective and technically sound manner. As described in Section 6.2 of this document, the initial phase of site characterization will include the following:

- Collecting sediment and surface water samples from 8 locations on site and 12 locations off site.

- Abandoning 25 improperly installed monitoring wells and piezometers;

- Collecting ground water samples for laboratory analysis from ~~72~~ 71 monitoring wells and piezometers;

At the completion of the site characterization activities, the Participating Respondents will prepare a draft RI report to summarize the results of the site characterization, define the source of contamination, describe the nature and extent of contamination, evaluate the fate and transport of contaminants, and include the results of the Baseline Risk Assessment (Task 5).

Task 5: Baseline Risk Assessment

At the completion of the site characterization task, Participating Respondents will prepare a Baseline Risk Assessment (described in Section 6.3 of this document), taking into account the following guidance documents and databases:

- Superfund Public Health Evaluation Manual (SPHEM);
- Superfund Exposure Assessment Manual (SEAM);
- Integrated Risk Information System (IRIS); and
- Public Health Risk Evaluation Database (PHRED).

In addition, the following U.S. Environmental Protection Agency (USEPA) documents from the Risk Assessment Guidance for Superfund (RAGS) Volume I may be utilized during the RI/FS process:

- o Part A - Human Health Evaluation Manual (Interim Final, December 1989);
- o Part B - Development of Risk-Based Preliminary Remediation Goals (Interim Final, December 1991); and
- o Part C - Risk Evaluation of Remedial Alternatives (Interim Final, December 1991).

A separate Environmental Evaluation Report will be prepared and will include a listing of any: (1) critical habitats, and (2) endangered species or habitats of endangered species. The Environmental Evaluation Report will take into account the following documents:

- o RAGS Volume II - Environmental Evaluation Manual (Interim Final, March 1989); and
- o Region V Scope of Work for Ecological Assessment (April 30, 1991).

Task 6: Treatability Studies

As described in Section 7.1 of this Site Background Summary and Detailed Scope of Work, the need for and extent of treatability studies (e.g., evaluation of cover materials) will be evaluated during the scoping and site characterization tasks for the RI/FS. Potential candidate treatability studies will be identified during the scoping phase (Task 1) of the RI/FS and discussed in the Work Plan. In this manner, the data gathering efforts conducted during the site characterization activities (Task 4) can be refined to ensure that sufficient information is collected to support the anticipated treatability studies. If it is determined that treatability testing is required, a Treatability Testing Work Plan will be submitted to IDEM for review and approval.

Task 7: Monthly Reports

Monthly progress reports consistent with the outline presented in Sections 6.4 of this document will be prepared during the RI/FS and submitted to IDEM in accordance with the Agreed Order governing this effort.

Task 8: Development and Screening of Remedial Alternatives

As described in Section 7.2 of this Site Background Summary and Detailed Scope of Work, the initial report prepared as part of the FS process will be an Alternatives Array Document (AAD) that presents the appropriate remedial alternatives for containment of a closed or partially closed hazardous waste landfill site. Section 6.1 of this document contains a preliminary listing of: (1) ARARs appropriate for containment of a closed or partially closed hazardous waste landfill site, (2) remedial action objectives, (3) general response actions, and (4) potential remedial

alternatives. The draft AAD will further evaluate these preliminary technologies to determine if they are still appropriate, or if additional alternatives should be reviewed based on the results of the site characterization task and the Baseline Risk Assessment.

Task 9: Detailed Analysis of Remedial Alternatives

The major effort conducted as part of the FS for the site will be a detailed analysis of the applicable remedial alternatives identified in the AAD that are appropriate for further analysis and review (Section 7.3). Each alternative will be evaluated with respect to the following criteria:

- Overall protection of human health and the environment;
- Compliance with ARARs;
- Long-term effectiveness and permanence;
- Reduction of toxicity, mobility, or volume of materials;
- Short-term effectiveness;
- Implementability;
- Cost;

- o USEPA acceptance; and

- o Community acceptance.

The alternatives will be compared with respect to the relative satisfaction of each of the aforementioned criteria in a draft FS Report, which will be prepared for IDEM's review and approval. After IDEM's comments have been addressed by the Participating Respondents, the final FS Report will be prepared and submitted to IDEM.

1.0 INTRODUCTION

This Site Background Summary and Detailed Scope of Work is being submitted to IDEM by the Four County Landfill Site Technical Committee on behalf of the Participating Respondents, in support of the Good Faith Offer submitted to IDEM on April 27, 1992. The Good Faith Offer and associated documents are being prepared in response to a Special Notice Letter, dated February 1992, and a draft Agreed Order and Statement of Work prepared by IDEM. This document presents:

- A summary of the existing data previously collected at the Four County Landfill Site located in northwestern Fulton County, Indiana, including a compilation and evaluation of available data regarding the site history, site physical characteristics, waste characteristics, and the nature and extent of contamination; and

- A detailed SOW for performing site stabilization activities, an RI, and an FS.

The Four County Landfill Site was owned by Environmental Waste Control, Inc. (EWC) of Wabash, Indiana, and operated as an Interim Status Facility, as defined by RCRA. After EWC submitted several unapproved RCRA Part B (Final Status) Permit Applications to the USEPA Region V and IDEM, landfill operations were ordered to be closed by a judicial decree. Shortly thereafter, EWC declared bankruptcy. The site is currently being regulated under the Indiana State Cleanup Authority (Code 13-7-8.7-11), with guidance from CERCLA and the NCP.

1.1 Location

The site is located in Aubbeenaubbee Township, in north-central Indiana, in the southern half of the southwest quarter of Section 16, Range 1 East, Township 31 North (Figure 1-1). The site is located approximately 3 1/2 miles southeast of the common corner of Fulton, Marshall, Starke, and Pulaski counties, near the intersection of State Highway 17 and County Highway 525 North. The nearest towns are Delong, located approximately one mile to the northeast of the site, and Leiters Ford, located approximately two miles to the east-southeast. The site is approximately six miles south of Culver and 15 miles northwest of Rochester.

The property occupies approximately 61.5 acres, including the County and State highway rights-of-way, and State Highway 17 divides the property into an eastern and western parcel. Land disposal activities were formerly conducted on approximately 30 acres of the western parcel, which has been the focus of investigative activities conducted at the site. The western parcel (i.e., the Four County Landfill Site) is bounded on the east by State Highway 17, on the north by County Highway 525 North, on the west by a county road right-of-way, and on the south by wooded land. Permanent site features have been surveyed, and a 100-foot site grid has been established (Figure 1-2). For ease in identifying specific site features, the western parcel has been divided into four geographic quadrants (i.e., the southeast, southwest, northwest, and northeast quadrants), which are arbitrarily defined by the 7+00 North and 8+00 East survey grid lines.

1.2 Site History

The following subsections present a chronology of the site history as it relates to ownership, general operations, regulatory actions, and investigative activities. More detailed information regarding the chronology of waste disposal is contained in Section 3.0. Historical information was obtained primarily from the following documents:

- "Hazardous Waste Ground-Water Task Force Evaluation of the Four County Landfill, Fulton County, IN," prepared by USEPA Region V and IDEM. Document Number: EPA-700 8-87-013, dated May 1987.

- "Comprehensive Monitoring Evaluation" (CME), prepared by Jacobs Engineering Group Inc. (Jacobs) in Lakewood, Colorado, for USEPA Region V. Final, dated January 27, 1988.

- "Corrective Action Plan (CAP) Task I - Description of Current Conditions," submitted by EWC and prepared by Geosciences Research Associates, Inc. (GRA) in Bloomington, Indiana. Final, dated December 7, 1989.

- "Four County Landfill Fact Sheet," ("Fact Sheet," 1990) prepared by Katten, Muchin & Zavis, Special Environmental Counsel for the bankruptcy estate, based on interviews with Mr. Stephen Shambaugh and Mr. James Wilkins of EWC. Document number: 00150573, dated October 12, 1990.

A listing of the substantive documents prepared as part of previous site investigations and regulatory activities is provided in Table 1-1. These documents were used to secure the background information presented in this Site Background Summary and Detailed Scope of Work, and are referenced throughout the document.

1.2.1 1972 to 1977

Prior to 1972, no landfilling or dumping operations were conducted on the property, which consisted of farmland. A document entitled "Engineering Report - Proposed Commercial Sanitary Landfill Project" was prepared by Mr. Joseph L. Tite on June 21, 1972. The report included a proposed site plan and soil boring logs for approximately six to eight borings that were advanced in both the western and eastern parcels. In July 1972, Mr. Avery Wilkins received approval from the Indiana State Board of Health (ISBH) and the Fulton County Commissioners to use the property as a sanitary landfill (GRA, CAP Task I, 1989). Operations began in August 1972, and in accordance with a permit from the ISBH, the site accepted primarily municipal waste with some liquids after 1972 (Jacobs, 1988). During this period of time, cut and fill and area fill landfilling operations were conducted at the site, and unlined waste deposits were covered with backfill ("Fact Sheet," 1990). On March 13, 1973, the ISBH sent Mr. Avery Wilkins a Notice to Cease and Desist regarding the dumping of barrels of waste solvent. The facility was also ordered to comply with ISBH's compaction and cover regulations.

1.2.2 1978 to 1981

On June 22, 1978, Mr. Stephen Shambaugh and Mr. Doug Johnson (as major shareholders) formed EWC to operate the Four County Landfill Site (GRA, CAP Task I, 1989 and "Fact Sheet," 1990). In September 1978, the ownership of the property containing the present landfill was transferred to Mr. James Wilkins (the son of Mr. Avery Wilkins). The landfill construction

and operating permits were transferred from Mr. Avery Wilkins to EWC in October 1978 (GRA, CAP Task I, 1989).

The ground water at the site was originally evaluated between December 1978 and February 1979 to determine whether the landfill could be permitted to accept "separate area waste," the ISBH's general definition for commercial and industrial waste prior to RCRA (USEPA, 1987 and "Fact Sheet," 1990). Monitoring wells MW-1 to MW-7 were installed by water well contractors in a surficial, glacial till, and at least one of these wells was located in each of the site quadrants shown on Figure 1-2. More specific well installation information is included in Section 2.5.2.

From November 1978 to November 1980, the site was approved by the ISBH to handle separate area waste that included plating sludge, municipal wastewater treatment sludge, asbestos (brake dust grindings), and liquid (including hydroxides and watered sludges) placed in unlined cells ("Fact Sheet," 1990). Additional information regarding the waste characterization, waste disposal, and cell construction is presented in Section 3.0. In November 1980, EWC requested and received a RCRA Part A Permit for Interim Status, and began using the State's manifest system ("Fact Sheet," 1990).

1.2.3 1982 to 1984

In 1982, EWC received letters from the ISBH stating that the existing ground water monitoring system was inadequate (Jacobs, 1988 and "Fact Sheet," 1990). Mr. James M. King, a consulting hydrogeologist, completed additional soil borings to a maximum depth of 80 feet in 1982. In May 1983, Salisbury Engineering in Griffith, Indiana, a division of ATEC Associates, Inc. (ATEC), installed three additional monitoring wells through the surficial till and into an unconfined aquifer comprised of silty sand (GRA, CAP Task I, 1989). ATEC reported their

results in a June 23, 1983 report entitled "Ground Water Study and Monitoring Well Installation." In October 1984, EWC notified the USEPA of statistical differences in ground water indicator parameters, particularly total organic carbon (TOC), and the need to further evaluate the ground water at the site. In addition, ATEC submitted the "Program Proposal - Ground Water Quality Assessment Plan" on November 1, 1984, in response to a formal complaint by the ISBH (GRA, CAP Task I, 1989).

Following several State and Federal inspections at the site, USEPA Region V submitted a formal request to EWC for a RCRA Part B Permit Application (Jacobs, 1988 and GRA, CAP Task I, 1989). EWC filed the first Part B Permit Application on January 31, 1984, and proposed to conduct landfill disposal of low-level, hazardous, industrial waste. Specific wastes listed on the application included emission control dust; wastewater treatment sludges; and wastes containing cadmium, chromium, and lead. The application indicated that EWC would not accept any ignitable, reactive, radioactive, acidic, or explosive wastes, or any wastes containing free liquids. In response to a letter from the USEPA, EWC provided additional information to clarify the deficiencies in the Part B Application (GRA, CAP Task I, 1989).

In 1984, Mr. Stephen Shambaugh bought out Mr. Doug Johnson's interest in EWC and became the sole owner and active operator of the site ("Fact Sheet," 1990).

1.2.4 1985 to 1988

Pursuant to the ATEC Ground Water Quality Assessment Plan, EWC installed three additional monitoring wells in the northeast quadrant of the site in April 1985. The deepest of these wells was installed in a gravelly sand unit to a depth of 122 feet (GRA, CAP Task I, 1989). Relative to the ground water issues, EWC and the Indiana Environmental Management Board entered into an Agreed Order (Cause No. N-128) in July 1985 that required EWC to prepare a ground water

assessment plan (GWAP), and submit the plan to the State for approval. On August 21, 1985, the first GWAP was submitted by ATEC (GRA, CAP Task I, 1989). IDEM did not approve the GWAP and subsequently notified the USEPA that the site was not in compliance with ground water monitoring requirements ("Fact Sheet," 1990). The USEPA sampled surface water and the existing monitoring well network in June 1986, and summarized the results of this site investigation in a report (USEPA, 1987). In October 1986, IDEM sent EWC a Notice of Inadequacy in response to the GWAP and requested the submission of a plan to describe the installation and location of additional wells (GRA, CAP Task I, 1989).

A data summary report (Dames and Moore, 1986) indicated that the GWAP should allow for modifications to the existing ground water monitoring system to improve the assessment of upgradient ground water quality at the site. Dames and Moore then prepared several versions of the "Hydrogeologic Assessment Report" between 1987 and 1988 to describe data associated with the installation of piezometers and additional monitoring wells. Concurrent with the Dames and Moore investigations, Mr. John Bassett of GRA was retained to provide an interpretation of the geologic setting and site stratigraphy. Initially, three stratigraphic units were identified at the facility: (1) a surficial till sequence; (2) a glacial outwash deposit; and (3) a second, deeper till. Discontinuous, perched water zones were found in the surficial till sequence; the aquifer was identified as an unconfined, glacial outwash unit; and the deeper till unit was interpreted as the base of this aquifer. GRA's detailed findings are included in the final "Hydrogeologic Assessment Report," dated January 12, 1988. This report identified the site's existing stratigraphic framework (i.e., Units A, B, C, and D), which is further described in Section 2.3.2 of this report.

The construction of the first synthetically lined disposal cell at the site was initiated in the fall of 1985 and completed in August 1986. Cell A, which was constructed in the southeast quadrant of the site, is double lined and has a leachate collection system ("Fact Sheet," 1990). More

detailed information regarding the location and construction of waste cells is provided in Section 3.0. According to the 1990 "Fact Sheet," after Cell A was completed, EWC began the construction of an additional lined cell (Cell B) and did not dispose of waste on any other portion of the property (i.e., in unlined cells). It is assumed that disposal in unlined cells occurred until the completion of Cell A in August 1986.

A group of local citizens, Supporters to Oppose Pollution, Inc. (STOP), was formed in December 1986. This group, as well as other area residents, opposed the operation and permitting of the facility as a hazardous waste disposal site, and presented opposing views to government agencies and the press (WW Engineering & Science, CAP Task II, 1991). STOP also videotaped the site and conducted a letter-writing campaign to politicians ("Fact Sheet," 1990).

In February 1987, the U.S. Department of Justice filed a civil action suit (Cause No. S87-55) against EWC, Mr. Shambaugh, and Mr. James Wilkins in the Federal Court of the Northern District of Indiana ("Fact Sheet," 1990). The Department of Justice alleged that ground water monitoring requirements had been violated and that EWC had falsely certified financial assurance and ground water monitoring compliance documents ("Fact Sheet," 1990). STOP intervened on behalf of the plaintiff (the United States) soon after the suit was filed. At this time, EWC ~~and the Four County Landfill~~ operated the landfill and managed several consultants working at the site, including:

- Mr. Richard Wigh of Regional Services Corporation (RSC) in Columbus, Indiana, who was working on cell construction at the landfill;

- Mr. Michael Johnson of Advanced Waste Management, Inc. (AWM) in Terre Haute, Indiana, who was performing engineering services;

- ATEC, which was working on hydrogeological studies; and

- Dames and Moore, the firm that had been retained to evaluate regulatory compliance information for both the RCRA Part B Permit Application and the ground water monitoring program ("Fact Sheet," 1990).

EWC's attorney at this time was Mr. George Pendygraft of Baker & Daniels. The site was still in operation, and the completed, lined Cell B was being filled while Cell C, also double lined, was under construction ("Fact Sheet," 1990).

On June 30, 1987, EWC submitted a revised RCRA Part B Permit Application to IDEM that included three bound volumes of text and 13 plan sheets. IDEM and USEPA Region V subsequently issued a document entitled "Fact Sheet - Intent to Deny a RCRA Operating Permit" and began a period of public comment on September 30, 1987. On January 18, 1988, EWC submitted a Part B Comments and Supplemental Information package to IDEM that consisted of seven bound volumes of text, including a position letter from Mr. Pendygraft and detailed responses to IDEM's "Fact Sheet." Following the public comment period, a Notice of Decision was issued by IDEM on June 30, 1988, stating that a final decision to deny the RCRA Part B Permit Application was appropriate (GRA, CAP Task I, 1989).

On January 27, 1988, Jacobs submitted their CME to USEPA Region V as an evaluation of the design and construction of the ground water monitoring system and the facility's ability to collect and analyze ground water samples. As a result of the inspection/evaluation, several RCRA violations and method deficiencies were identified (Jacobs, 1988). EWC submitted a proposed RCRA Interim Status "Groundwater Monitoring Plan" to IDEM on June 2, 1988. This plan proposed: (1) the construction of more than 70 new or replacement monitoring wells and piezometers to be installed as clusters at multiple depths within the A, B, and C stratigraphic units defined in the GRA and Dames and Moore reports; and (2) a detailed sampling and laboratory characterization of soil materials (GRA, CAP Task I, 1989). Although some of the monitoring wells proposed in this Plan were designed to replace existing wells that were constructed inappropriately (e.g., with long filter packs), no information regarding well abandonment was presented.

IDEM approved EWC's Plan in July 1988, and between November 1988 and December 1989, EWC installed the most recent series of wells and piezometers (GRA, CAP Task I, 1989). In accordance with the Plan, test borings were advanced to bedrock at locations near the four corners of the site (i.e., to a maximum depth of 217 feet below ground surface), and wells were installed at variable depths in the aquifer (GRA, CAP Task I, 1989).

The complete results of the 1988 and 1989 investigations are presented in two "Memorandum Reports" prepared by Mr. Bassett of GRA: (1) dated April 28, 1989 and submitted to Mr. Pendygraft; and (2) dated December 15, 1989 and sent to Mr. Shambaugh. These memoranda include soil boring logs, soil analytical data, and well/piezometer completion diagrams. As described in these memoranda, solvent odors were detected in a thin, shallow sand seam within the upper till unit at several locations in the northwest quadrant of the property. Subsequent to the detection of volatile organic compounds (VOCs) within the perched water of this unit, EWC

installed a crude ground water recovery sump (sump P-34A) as an interim corrective measure (Section 3.3).

On December 5, 1988, the civil suit filed by the Department of Justice (Cause No. S87-55) went to trial in the U.S. District Court, Northern District of Indiana, South Bend Division with Judge Robert L. Miller, Jr., presiding (GRA, CAP Task I, 1989). West Holding Company, Inc. (WHC), a wholly owned subsidiary of EWC, was formed in 1988 to hold the real estate for the site and reportedly to simplify the business arrangement between Mr. James Wilkins and Mr. Shambaugh ("Fact Sheet," 1990). WHC was also named as a defendant in the civil suit (GRA, CAP Task I, 1989).

1.2.5 1989 to Present

On March 29, 1989, the U.S. District Court ordered a $2.88 million fine against Mr. Shambaugh and Mr. Wilkins jointly and severally. Facility operations were ordered closed immediately, and the U.S. District Court ruled that a RCRA Facility Investigation (RFI) Corrective Action Plan (CAP) would have to be implemented at the site ("Fact Sheet," 1990). At the time of the court decision, Cell C had been completed and was in use. Two weeks after the court decision, Mr. Shambaugh, Mr. James Wilkins, EWC, and WHC filed for Chapter 11 bankruptcy ("Fact Sheet," 1990).

In June 1989, GRA began collecting data to fulfill Task I (Description of Current Conditions) of the proposed CAP, under the direction of the USEPA Region V, RCRA Enforcement Branch. The District Court decision was appealed to the 7th Circuit Court of Appeals (GRA, CAP Task I, 1989) and was subsequently affirmed.

On April 12, 1990, RSC submitted a GWAP to IDEM on behalf of EWC. This GWAP was approved by IDEM on October 10, 1990, with extensive attached modifications, to fulfill the requirements of the original July 1985 Agreed Order. Pursuant to the March 1989 Judicial Decree for a CAP, EWC submitted several progress reports, including ground water and sump sampling results, to the USEPA Region V, RCRA Enforcement Branch, between April 1990 and July 1991. Several CAP project plans were prepared by WW Engineering & Science in Grand Rapids, Michigan and Bloomington, Indiana (formerly GRA). These documents consisted of an RFI Work Plan (Task II of the CAP) and a January 31, 1990 corrective measures study (Task VI of the CAP). The Work Plan was approved with modifications by USEPA Region V, RCRA Enforcement Branch in January 1991, and a final version reflecting these modifications was submitted by WW Engineering & Science on March 11, 1991.

According to a June 13, 1991 progress report from EWC to USEPA Region V, WW Engineering & Science notified EWC that they would not continue their involvement in the project because of EWC's financial insecurities. In December 1991, IDEM began a unilateral removal action to stabilize the facility, including the collection, storage, and disposal of leachate and erosion control measures (IDEM Draft Statement of Work, February 1992). OHM Remediation Services Corporation began these site maintenance activities under the direction of IDEM.

2.0 SITE PHYSICAL CHARACTERISTICS

The physical characteristics of the site and surrounding area, as described in this section, were derived from available information concerning regional and site-specific surface features, surface water, geology, soils, hydrogeology, climate, land use, and ecology. This information will be used during the completion of the RI/FS to assist in: (1) defining transport pathways and receptor populations, and (2) providing sufficient engineering data for the development and screening of remedial action alternatives.

2.1 Surface Features

In 1988, the USEPA's Environmental Photographic Interpretation Center (a branch of the Advanced Monitoring Systems Division of the Environmental Monitoring Systems Laboratory) performed a review of historical aerial photographs of the Four County Landfill Site and surrounding properties. This review was conducted at the request of the Environmental Monitoring Branch of USEPA Region V and the Office of Waste Programs Enforcement - RCRA Enforcement Division. Historical black-and-white photographs from 1951, 1957, 1958, 1963, 1971, 1978, 1980, and 1986; color photographs from 1987; color, infrared photographs from 1981; topographic maps; and information obtained from USEPA Region V were evaluated during the review. The findings of the review, entitled "Site Analysis - Four County Landfill" (April 1988), assisted in the preparation of this subsection and Section 3.0, which describes source characterization. However, the detailed historical photograph analysis is not repeated here.

2.1.1 Regional

The regional surface features information included in this subsection was obtained primarily from the "Geologic Setting of the Four County Landfill, Fulton County, Indiana" report dated June 5, 1987, prepared by GRA.

The site is situated in a rural, sparsely populated area consisting of a mixture of agricultural land and woodlands. The area is included in the Steuben Morainal Lake area (Wayne, 1956) of the Northern Lake and Morainal Region physiographic unit (Malott, 1922). The general area is underlain by approximately 200 feet of Late Wisconsinan drift consisting of till; outwash sand and gravel; fine-textured lacustrine materials; ice-contact stratified drift; and dune sand. Upland areas generally exhibit a hummocky topography with numerous marshy depressions and steep-walled troughs that are characteristic of ice-disintegration features. Ice-contact stratified drift features, consisting of sand and gravel in the form of circular kame deposits, are common. Numerous marshy areas underlain by peat and marl occur in kettle holes formed by the melting of Late Wisconsinan glacial ice. Natural elevations in the immediate areas surrounding the landfill range from about 730 to 795 feet above mean seal level (amsl).

2.1.2 Site Specific

As mentioned previously, the landfilled portion of the property is bounded on the east by State Highway 17, on the north by County Highway 525 North, on the west by a county road right-of-way, and on the south by wooded land. The landfilled area consists of lined cells that dominate the southeast quadrant, and unlined waste deposits in the northwest and southwest quadrants (Figure 2-1). Although a 15- to 20-foot-high ridge originally crossed the property from the northwest to the southeast, this site topography was modified by the landfilling activities (Jacobs, 1988). The topography is currently representative of filled areas and cell excavations, with

elevations ranging between approximately 760 to 800 feet amsl. In general, the upper surface slopes away in all directions from the south-central region of the site.

An office, a water supply well, a laboratory, and a wheel/truck wash (i.e., former support facilities) were located in the southeast quadrant of the site (Figure 2-1). However, after June 1987, the office and laboratory were moved to the eastern parcel of property, which is located to the east of State Highway 17 (Figure 1-1). A new support facility and wheel/truck wash were built in the northwest quadrant (Figure 2-1).

A site topographic map (Figure 2-2) prepared by RSC as part of the RCRA Part B Permit Application process shows the March 1987 area topography at a 5-foot contour interval. In 1986 and 1987, a new chain-link fence was installed around the perimeter of the property, and signs that read "DANGER - Unauthorized Personnel Keep Out" were affixed to the site fence, as reported in the Closure and Post-Closure Plans submitted in April 1989.

2.2 Surface Water

2.2.1 Regional

As a result of glaciation, the area surrounding the site contains a number of small swamps, streams, and lakes, including 24 natural lakes within Fulton County (Harrell, 1935). Lake Maxinkuckee is located approximately five miles to the north, and Bruce Lake is approximately five miles southwest of the site (Figure 2-3). King Lake, which covers approximately 18 acres, is located approximately 0.25 mile east of the site and has a north-flowing outlet to the Tippecanoe River (Figures 1-1 and 2-2). The Tippecanoe River flows in a generally northwesterly direction, and is located approximately one mile north of the site. Prior to landfilling activities, surface drainage from the area was split along the ridge that extended from

the northwest to southeast across the site. The runoff from the north and east areas drained easterly toward King Lake. The south and west areas drained generally to the west-northwest, eventually joining the northwest-trending ditch that flows into the Tippecanoe River.

According to wetland inventory maps produced by the U.S. Fish and Wildlife Service (USFWS) and the Indiana Department of Natural Resources (IDNR), palustrine (nontidal marsh) forested wetlands with open aquatic beds and emergent vegetation are present around the site (Jacobs, 1988 and Cowardin et al., 1979). Based on a review of topographic maps of the area, the three major areas receiving runoff from the site include: (1) a wetland basin to the north of the site, (2) forested wetlands and King Lake to the east of the site, and (3) a series of connected wetlands and an unnamed stream/ditch to the south and west of the site.

The wetland basin to the north of the site also receives surface drainage from small areas northwest of the landfill. According to the RFI CAP Task II Work Plan (WW Engineering & Science, 1991), private dumping has occurred to the north of County Highway 525 North in the vicinity of this basin.

2.2.2 Site Specific

Surface water runon enters the site from the wooded southern boundary and is directed through a ditch to an area of natural drainage off the western edge of the site. Water from this area eventually drains to the unnamed, northwest-trending ditch that flows to the Tippecanoe River. Nonleachate runoff (i.e., runoff that does not come into contact with the active portion of the landfill) is collected in a series of ditches and drainage control ponds, stored in either the southwest retention pond or the northeast drainage control basin (Figure 2-1), and ultimately discharged from the northeast drainage control basin pursuant to a National Pollutant Discharge Elimination System (NPDES) Permit. EWC originally obtained the NPDES Permit from IDEM

on September 24, 1986. The expiration date, ordinance limits, and discharge limits are specified in the permit, which was included as an appendix in the 1987 RCRA Part B Permit Application. The on-site discharge point allows water to collect in the northeast quadrant, then drain into a culvert under County Highway 525 North that empties into the wetland basin north of the site.

2.3 Geology

2.3.1 Regional

The regional geology information included in this subsection was obtained primarily from the June 5, 1987 "Geologic Setting of the Four County Landfill, Fulton County, Indiana" report by GRA and the January 27, 1988 CME by Jacobs.

The bedrock in the area of the site in Fulton County is covered by a mantle of unconsolidated glacial deposits. Area bedrock consists of middle Devonian Age carbonate rocks, which are part of the Muscatatuck Group. A bedrock core from a well located approximately 2.5 miles east of the site is described in Doheny, et al. (1975). At that location, there are 67.1 feet of lithographic to bioclastic limestone and fine-grained to saccharoidal dolomite belonging to the Devonian Age Traverse and Detroit River Formations. These Devonian formations overlie 11.9 feet of vuggy Silurian dolomite, assigned to the Salina Formation, which, in turn, overlies 173.7 feet of fine-grained Silurian dolomite assigned to the Wabash Formation. A similar sequence of thick limestone and dolomite bedrock would be expected beneath the site. A structure contour map of the top of the Detroit River Formation (Devonian) prepared by Doheny, et al. (1975) suggests that the bedrock units dip gently to the north or northeast at about 10 feet per mile, away from the Kankakee Arch and toward the Michigan Basin structural feature.

The bedrock in Fulton County is unconformably overlain by glacial deposits that range in thickness from 100 feet to more than 250 feet (Gray, 1982). Regionally, northwestern Fulton County is located between areas known to have been covered by Michigan Lobe ice to the southwest, and Huron-Erie Lobe ice to the southeast. The resultant, complex stratigraphy is typical of interlobate glaciated areas. Wisconsinan Age glacial deposits in Indiana include ground moraine deposits, end moraine deposits, and ice-contact stratified drift of the Trafalgar, Lagro, and Atherton Formations (Schneider and Keller, 1970). The ground moraine is relatively flat lying and consists of till or unsorted gravel, sand, silt, and clay that was deposited by advancing and retreating glaciers. End moraine sediments, comprised primarily of till with smaller areas of stratified sand and gravel, were deposited as ridges. These ridges mark the maximum extent of the ice or a pause in glacial retreat. The Maxinkuckee end moraine forms a prominent ridge in western Fulton County. Smaller areas of Wisconsinan Age, ice-contact stratified sand and gravel, which were deposited by running water at the margins of the ice, also occur throughout the region (Schneider and Johnson, 1967).

Additional glacial deposits include valley train and outwash sand and gravel, dune sands, and lake sediments of the Atherton Formation. Sand and gravel were deposited by meltwater streams that flowed from the margins of the glacier and meandered back and forth creating outwash plains. As the ice continued to recede, wind reworked the outwash deposits into dunes. Layers of clay, silt, and fine sands were formed in areas where water was temporarily impounded in lakes or ponds. The general location of the Four County Landfill Site relative to these deposits is shown in Figure 2-3. The site is situated on the Delong end moraine, which overlies glacial outwash sand and gravel.

2.3.2 Site Specific

Unconsolidated sediments at the site are up to 220 feet thick, consist of four major litho-stratigraphic units (Units A, B, C, and D), and overlie carbonate bedrock. Figure 2-4 is a generalized stratigraphic section of the site, prepared by GRA. The site-specific stratigraphy was characterized primarily by Mr. Bassett of GRA in a memorandum report to Mr. Wigh of RSC on January 11, 1988. The original framework was refined after extensive drilling work in 1988 and 1989 and presented in the two GRA "Memorandum Reports" (April 28, 1989 and December 15, 1989). The four relatively distinct stratigraphic units and the bedrock encountered at the site are described in detail in the following subsections.

2.3.2.1 Unit A

Stratigraphic Unit A consists of a sequence of four, distinct subunits of loam and silt loam glacial till that probably represent separate phases of glacial deposition. From top to bottom, the stratigraphy is comprised of: (1) a surficial, brown, weathered loam till (subunit A1); (2) a mixture of gray, silt loam and loam till (subunits A2 and A22); and (3) a brittle, hard, olive-gray silty till (subunit A3). Ground water in the Unit A till sequence occurs in discontinuous perched zones within stratified intertill sand and gravel deposits. Several piezometers and an older series of monitoring wells have been installed in Unit A; however, these wells do not yield significant quantities of water and do not have consistent water level readings.

2.3.2.2 Unit B

Stratigraphic Unit B (a glacio-lacustrine sequence) underlies Unit A and is comprised of well-stratified, fine- to medium-grained sand and interbedded silt. At most locations, a very sharp basal contact with the Unit A till sequence was observed (i.e., a thin weathering zone marked

by an oxidized loam or a brown pebbly sand). Although the contact between Units A and B varies considerably in elevation across the facility (Figure 2-5), Unit B has a relatively uniform thickness of 28 to 42 feet and appears to contain three major silt beds: one near the top, a second in the middle portion, and a third marking the base. The silt bed in the middle portion of the unit seems to be continuous and serves as a marker horizon. The base of Unit B (i.e., the top of Unit C as illustrated on Figure 2-6) is also an irregular surface, with a pattern similar to the top of Unit B, and is arbitrarily mapped at the bottom of the lowermost silt bed.

Unit B is interpreted as a subaqueous deposit associated with a prograding delta front. The top of the aquifer (water table) generally lies within Unit B, at an elevation between approximately 725 and 730 feet amsl (Section 2.5.2).

2.3.2.3 Unit C

Soil samples collected from borings completed through stratigraphic Unit C suggest that the unit consists of glacio-fluvial sediments composed of an upper (upward fining) sequence overlying a lower (upward coarsening) sequence that cuts unconformably and irregularly into an older glacial till (Unit D). The top of the upper sequence is gradational with the overlying Unit B and is arbitrarily placed at the base of the lowest silt bed in Unit B. The upper part of Unit C coarsens downward to a zone of coarse sand, sandy gravel, and gravel, designated as subunit C2.

Subunit C2 is comprised of a more permeable sand and gravel layer that occurs at elevations between 680 and 690 feet amsl. Below subunit C2, the top of the lower sequence is marked by a discontinuous pebbly loam ("diamict") or a zone of massive, gray, silty mud. Fine sands are also found in this interval. The pebbly loam contains abundant stratified material and is interpreted as a proximal mud flow adjacent to an advancing ice lobe. The gray, silty mud and

fine sand units possibly represent lower energy deposition in ponded areas adjacent to and resulting from the mud flow(s). Regardless of their origin, the silty mud and fine sands are closely associated, and where present, separate Unit C into an upper and lower sequence.

Although Unit C wells installed in 1988 and 1989 are identified by subunit C1 to C4 designations (e.g., P-27C3), these subunits are not intended to be part of a formal stratigraphic hierarchy. Rather, they are informally defined and relate primarily to the elevation of the coarser "C2" horizon, as well as the relative contacts with Units B and D.

The lower sequence of Unit C thins from north to south. In the northwest quadrant, over 100 feet of sand and gravel underlie the "muddy zone" of Unit C and directly overlie Devonian carbonate bedrock. At the southern margin of the southwest quadrant, the lower sequence of Unit C is approximately 5 feet thick and overlies glacial till (Unit D). The base of Unit C slopes steeply to the north, as illustrated in Figure 2-7. The thickness of Unit D at selected data points is also shown in Figure 2-7.

2.3.2.4 Unit D

Stratigraphic Unit D consists of unconsolidated loam- or finer-textured glacial till that has been entirely removed in certain areas, presumably by glacial meltwater scouring. Where present, the till unconformably overlies carbonate bedrock of Devonian Age. The maximum thickness of Unit D is 47 feet, in the southwest quadrant of the site. The unit thins abruptly to the north and is cut out by sand and gravel in the lower part of Unit C. The basal portion of Unit D is appreciably more clayey and reddish than the upper portion. It is not known whether this is related to the incorporation of residual clay soil material into the basal portion of a single till unit, or whether two distinct till units exist. No geotechnical analyses of the basal till were

performed because of the very mixed nature of the circulated mud-rotary samples from this depth.

2.3.2.5 Bedrock

Bedrock beneath the facility is comprised of carbonate (limestone and dolomite) bedrock of middle Devonian Age, probably of the Detroit River Formation. Approximately four feet of light-gray to dark-brown, fine- to coarsely-crystalline limestone and dolomite were penetrated at four separate locations at the site.

To correlate the detailed stratigraphic data across the site, GRA prepared two detailed, north-south cross sections (A-A' and B-B') at the locations shown on Figure 2-8. Figures 2-9 and 2-10 illustrate cross sections A-A' and B-B', respectively, and present representative borehole geophysical data (natural gamma ray logs) collected for most of the deeper piezometers installed in 1988 and 1989. As described in the April 28, 1989 Memorandum Report by GRA, traces of the natural gamma logs were overlain on the lithologic logs generated in the field to confirm the observed site stratigraphy.

2.4 Soils

2.4.1 Regional

The regional soils information included in this subsection was obtained primarily from the U.S. Soil Conservation Service document entitled Soil Survey of Fulton County, Indiana, which was completed by G. Franklin Furr, Jr., in July 1987. According to Furr, northwestern Fulton County is dominated by the Wawasee soil series, which consists of deep, well-drained, moderately permeable soils formed on glacial till plains and moraines. Slopes range from 2 to

18 percent. The thickness of the upper part of the profile, where soil formation processes are active, is approximately 28 to 40 inches. The A horizon is medium-acid to neutral and consists predominantly of fine, sandy loam and lessor amounts of sandy loam and loam. The B horizon is generally a loam or sandy clay loam, with strongly acid to neutral reactions, and the C horizon is primarily composed of a fine sandy loam or loam. These soil horizons (i.e., A, B, and C) should not be confused with the stratigraphic Units A, B, C, and D.

2.4.2 Site Specific

During drilling activities conducted at the site, numerous Shelby tube and split-spoon soil samples were collected, inspected, and analyzed for geotechnical parameters. For example, the Dames & Moore "Hydrogeologic Assessment Report" dated January 12, 1988, presents the results of soil classification tests completed for samples collected during 1986 and 1987 investigations from the Unit A till sequence (Table 2-1). The sample classifications were determined based upon sieve analysis, hydrometer testing, and/or Atterberg limits testing, and the soils were designated according to the U.S. Department of Agriculture's (USDA's) system and the Unified Soil Classification System (USCS).

The results of laboratory permeability testing for the samples collected by Dames & Moore between 1986 and 1987 are also shown in Table 2-1. In general, the falling head permeability tests indicate that the Unit A soils have permeabilities ranging from 10^{-8} to 10^{-5} cm/sec. Several representative soil samples were also analyzed for cation exchange capacity (CEC) and calcium carbonate equivalency. The CEC results ranged from less than 1 to a high of 18.3 millequivalents (meq)/100 grams. The higher CEC values were generally measured in the upper glacial soils (Unit A), the interbedded silt layers, and the till material (Unit D) underlying the sand and gravel aquifer, all of which have moderate to low percentages of silt- and clay-size material. The lower CEC values (less than 1 meq/100 grams) were measured in the

predominantly sand deposits of the glacio-lacustrine sequence (Unit B) and the glacio-fluvial sequence (Unit C). The soil analytical results and the pH and acid reaction tests completed by Dames & Moore in the field indicated a "closed-environment condition," with no evidence of oxidized or weathered zones from previous soil development within the Unit A till sequence (Dames & Moore, 1988).

During the 1988 and 1989 investigations by GRA, selected soil samples were analyzed for CEC, calcium carbonate equivalency, and texture (including sieve and hydrometer testing). The results of these tests are summarized in Tables 2-2 and 2-3. The CEC values fell into a fairly narrow range, 2.3 to 5.9 meq/100 g, probably because all of the GRA samples were collected from stratigraphic Unit A. The calcium carbonate equivalency values ranged from 18.8 to 28.8 percent, which are comparable to the data obtained by Dames & Moore during their investigation of Unit A.

2.5 Hydrogeology

2.5.1 Regional

The regional hydrogeology information included in this subsection was obtained primarily from the CME (Jacobs, 1988). According to Rosenshein and Hunn (1964), "... few water wells have been drilled into the rocks of Devonian [Age]," and "[a]lthough these limestone and shales are not extensively used as a source of water in Fulton County, they are a potential source of water of which quality and quantity available is uncertain." Reportedly, a well located in the township directly east of the site (Richland Township) was installed in limestone and had a drawdown of 50 feet after being pumped for two hours at 10 gallons per minute (Rosenshein and Hunn, 1964).

Glacio-fluvial sand and gravel deposits are the chief sources of ground water for domestic, stock, industrial, and public supplies in Fulton County (Rosenshein and Hunn, 1964). Both confined and unconfined aquifers are present within the unconsolidated deposits. Wells that tap these aquifers are generally less than 150 feet deep and yield from 5 to 1,000 gallons per minute (gpm). Water hardness typically is between to 200 to 450 parts per million (ppm), and iron content is generally higher than the secondary maximum contaminant level (SMCL) of 0.3 ppm established in the Safe Drinking Water Act of 1974. Examples of ionic species concentrations are: iron at 0.1 to 7.5 ppm, bicarbonate at 151 to 532 ppm, sulfate at 5 to 175 ppm, and hardness (as calcium carbonate) at 180 to 540 ppm (Rosenshein and Hunn, 1964).

Glacial till deposits in Fulton County are not a viable source of ground water. These fine-grained, heterogeneous deposits typically are not sufficiently extensive and cannot transmit water at the rate necessary to sustain yields for even modest domestic supplies (Dames & Moore, 1988).

As reported in the "CAP Task I - Description of Current Conditions" by GRA, ground water is used for domestic supply at some locations within a 0.5-mile radius of the site. Appendix A contains area water well logs obtained by GRA from the files of the IDNR Division of Water. The locations of these wells are shown in Figure 2-11, with numeric designations that correspond to the hand-written numbers on the Appendix A logs. The ground water supply in the general area appears to be derived from the glacio-fluvial aquifer corresponding to the stratigraphic Unit C (GRA, CAP Task I, 1989).

Based on regional topography and nearby surface water locations and elevations, the regional ground water flow direction appears to be north and northeast, toward the Tippecanoe River. The hydraulic conductivity (permeability) of the glacio-fluvial and glacio-lacustrine aquifers could be expected to fall within the range of 10^{-1} to 10^{-5} cm/sec (Fetter, 1988).

2.5.2 Site Specific

Available records indicate that a total of 118 monitoring wells, piezometers, and water supply wells have been installed on the site. Table 2-4 contains a list of individual wells and well clusters that are grouped according to the associated site quadrant locations shown on Figure 1-2. Monitoring well MW-8 was originally installed as a water supply well for a residence formerly located in the northwest quadrant of the property (GRA, CAP Task I, 1989). In addition, two other water supply wells were identified at the site, including a 6-inch diameter well in the northwest quadrant and a well located near the former support facilities (trailer) in the southeast quadrant (Figure 2-1).

In addition, the following monitoring wells and piezometers were installed at the site between 1978 and 1989:

- Seven wells (MW-1 through MW-7) between December 1978 and February 1979 by water well contractors;

- Six wells (MW-20, MW-21S, and MW-22 between May and June 1983, and MW-23S, MW-23M and MW-23L in April 1985) by ATEC;

- Twelve wells (MW-21M, MW-21L, MW-24S, MW-24M, MW-24L, MW-24L2, MW-25, MW-26, MW-27S, MW-27M, MW-28S, and MW-28M) and four piezometers (P-1, P-2, P-3, and P-3A) between 1986 and 1987 by Dames & Moore; and

- All of the remaining piezometers and wells in 1988 and 1989 by GRA.

A summary of available construction data and stratigraphic information for the monitoring wells and piezometers installed at the site is provided in Table 2-5. A piezometer/monitoring well cluster with a numeric designation of "34*" was installed by GRA between December 1988 and January 1989. The asterisk (*) is not a footnote, but rather a means of distinguishing this cluster from "P-34A," a piezometer formerly located in the northwest quadrant.

Although all of the wells are constructed of polyvinyl chloride (PVC) material, those installed prior to 1988 are constructed according to various specifications. In some cases, the effective well screen length (including the sand pack) is inappropriately long. For this reason, several monitoring wells and piezometers are proposed for abandonment (Section 6.2.1.4).

Several rounds of water level data were collected by GRA in 1989 and tabulated according to separate "hydrostratigraphic" units (including Unit B, C1, C2, C3, and C4). Water table contour maps generated from these data generally indicate a north to northeasterly ground water flow direction with a very gentle horizontal gradient and a negligible vertical gradient. These data indicate that stratigraphic Units B and C act as a single, unconfined or partially confined aquifer (i.e., depending on the elevation of the base of stratigraphic Unit A).

A generalized geologic cross section has been completed for each of the four site quadrants, based on data from pre-existing cross sections, soil boring logs, and well construction forms. Figures 2-12 through 2-15 are provided as a graphical representation of the monitoring points located in each quadrant and the depth of the effective screen lengths relative to the established site stratigraphy. These figures are not intended to replace the detailed stratigraphic cross sections generated by GRA (Figures 2-9 and 2-10), but rather to facilitate a visualization of the

number and depth of all known ground water monitoring points in the landfilled area. As indicated on Figures 2-12 through 2-15, several monitoring points have effective well screens longer than 50 feet, and the screened intervals of wells overlap within individual clusters.

As described in the "Hydrogeologic Assessment Report" (January 12, 1988), Dames & Moore completed slug tests in 1987 to determine the hydraulic conductivity at five monitoring wells installed in Units B and C. The hydraulic conductivity values, which were calculated by using two separate analytical solutions, ranged between 10^{-6} and 10^{-4} cm/sec (Table 2-6). By using the average hydraulic conductivity values derived from the field slug tests, the laboratory permeability tests of Unit B and Unit C aquifer material, and representative ranges of the site hydraulic gradient and effective soil porosity, Dames and Moore estimated ground water flow velocities between 4.8×10^{-8} and 1.6×10^{-5} cm/sec (0.05 to 17 feet per year).

2.6 Climate

The climate information included in this subsection was obtained primarily from the Soil Survey of Fulton County, Indiana (Furr, 1987). According to Furr, the following climatic data was obtained from the Rochester, Indiana recording station for the period from 1951 to 1974:

- The average winter temperature was 26° F, and the average summer temperature was 68° F.

- The lowest temperature on record (-23° F) was on January 29, 1963, and the highest recorded temperature (101° F) occurred on September 2, 1953.

- The average annual precipitation was approximately 37 inches. Approximately 23 inches of rain, or more than 63 percent of the annual total, usually fell between April and September. The heaviest one-day rainfall event during the period was 4.72 inches on April 29, 1956.

- Thunderstorms occurred on approximately 40 days each year. Occasional tornados and severe thunderstorms were local in extent, lasted for only a short duration, and caused damage in scattered areas.

- The average seasonal snowfall was about 25 inches, and the greatest snow depth at any one time was 11 inches. On average, 18 days of the year had at least one inch of snow on the ground; however, the number of such days varied greatly from year to year.

- The average relative humidity in mid-afternoon was about 60 percent. Humidity was higher at night, and the average at dawn was about 80 percent.

- During a 24-hour period, the sun was shining 70 percent of the time in the summer and 40 percent of the time in the winter.

- The prevailing wind direction was from the southwest, and the average wind speed was generally highest (i.e., 12 miles per hour) in the spring.

2.7 Land Use

According to the Soil Survey of Fulton County, Indiana (Furr, 1987), Fulton County was organized on January 23, 1836. About 70 percent of the county is farmed, primarily for corn, soybeans, and wheat. In 1974, the county had 1,104 farms, with an average size of 186 acres. Agriculture is the main source of income and employment, and the area businesses and industries are relatively small.

Fulton County had a population of 17,453 in 1900; 15,577 in 1940; 16,984 in 1970; and 19,208 in 1980. The major concentration of the population is in and near Rochester, which is the largest town in the county. Rochester had a population of 5,016 in 1980. Some of the population is concentrated around the other small towns in the area.

During the period from 1958 to 1967, the number of acres of land under urban development increased by about 15 percent, and all categories of agricultural land decreased by the same amount. In 1974, approximately 87 percent of the county remained agricultural land. As of 1987, approximately 100 acres or less were being converted to urban uses, and this trend was expected to continue at a similar rate for several years (Furr, 1987).

The area to the west of the site is open and used for agricultural purposes, and properties to the north, south, and east are wooded and sparsely populated, with residents situated on scattered, small farms. The primarily white, middle class population is involved in agricultural activities, with no notable distributions by age or sex. Land use consists of small farm and dairy operations. Ground water is the primary source of potable water for the residents (Agency for Toxic Substances and Disease Registry, 1990).

During a U.S. Geological Survey (USGS) biota study conducted in January 1988, 64 residences and one church were noted on the land within 0.5 mile of the site. Forty-five (45) of these residences were occupied, and the other 19 appeared to be cottages used only during the summer months (GRA, CAP Task I, 1989).

A plat survey and listing of owners of property adjacent to the Four County Landfill is presented in the CAP Task I report. According to this document, the property immediately north, south, and east of the site has been separated into many small plats that were never developed.

2.8 Ecology

Mr. Donald Steffeck of the USFWS's Bloomington, Indiana field office prepared a report entitled "A Survey for Contaminants in Selected Biota Near the Four County Landfill, Fulton County, Indiana" (October 1988). This document includes a detailed listing of the fish and wildlife populations supported by the habitat near the site. During a reconnaissance of the study area, a number of migratory bird species were noted, particularly in the wetland areas. More specifically, the following species were identified during the on-site inspection: great blue heron; American woodcock; red-tailed hawk; killdeer; mourning doves; and a number of passeriforms, including song sparrows, northern juncos, and robins. A complete listing of the Federal- and State-listed endangered species potentially found in Fulton County, Indiana is provided in the original USFWS document.

As part of the USFWS study, fish and wildlife populations were observed near the site. A relatively high population of white-tailed deer and indications of raccoon, opossum, beaver, Eastern cottontail, fox, squirrel, and chipmunk were noted.

3.0 SOURCE CHARACTERIZATION

The available source ~~site~~ characterization data summarized in this section include: (1) the locations ~~of, potential releases, and engineering characteristics of the~~ waste disposal areas and the disposal methods used; (2) the type and quantity of wastes that may be contained in or released to the environment; and (3) the interim corrective measures previously completed at the site. ~~the physical and/or chemical characteristics of the wastes present.~~ The information described in this section was taken primarily from the USEPA's "Hazardous Waste Ground-Water Task Force Evaluation of the Four County Landfill, Fulton County, IN" dated May 1987.

3.1 History of Disposal and Containment

The Four County Landfill began operation in August 1972; and from 1972 to 1978, the site was licensed as a sanitary landfill by the ISBH. From November 1978 to November 1980, the site was approved by ISBH to handle separate area waste. From November 1980 until it closed in March 1989, the landfill was operated as an Interim Status RCRA facility that accepted hazardous waste for disposal, but did not treat or store hazardous waste (Jacobs, 1988). The facility also accepted sanitary waste for a brief period of time in 1982 to 1983 (Jacobs, 1988). As described in Section 1.2, the Four County Landfill property was originally owned and operated by Mr. Avery Wilkins, operated by EWC after 1978, and owned by WHC after 1988.

The area of the site used for the disposal of waste materials consisted of less than 30 acres (WW Engineering & Science, CAP Task VI, 1990). Areas of unlined deposits are primarily located in the northwest and southwest quadrants, as indicated on Figure 3-1. The portions of the landfill area designated as Cells A, B, and C (located in the southeast quadrant of Figure 3-1) are double-lined disposal units with double-leachate collection systems. Cells A and B are nearly

filled to capacity, and Cell C has an unused capacity of approximately 100,000 cubic yards (WW Engineering & Science, CAP Task VI, 1990). Surface water has collected in the lined depression of the unused portion of Cell C.

EWC temporarily stored leachate in aboveground tanks that were initially located in the support facility of the northwest quadrant, and later situated adjacent to the lined cells. A wheel/truck wash with a total capacity of approximately 1,000 gallons is currently located immediately southeast of the support facilities in the northwest quadrant. Rinse water from this unit was periodically removed and transported to the leachate tanks (RSC, 1989). According to the April 13, 1989 "Closure and Post-Closure Plans" prepared by RSC, the maximum inventory at the site was estimated to be 27,000 gallons of leachate; 385,249 cubic yards of RCRA waste; 51,486 cubic yards of special waste; and 65,000 cubic yards of general refuse (Table 3-1).

3.1.1 Unlined Deposits

Before 1978, the State of Indiana did not require wastes to be separated as hazardous or non-hazardous. Therefore, the General Refuse Area shown on Figure 3-1 contains a mixture of general refuse, commercial, and industrial waste (USEPA, 1987). During 1974, Fulton County opened a landfill for general refuse, and the volume of general household refuse received at the landfill was reduced (USEPA, 1987). Therefore, between 1974 and 1978, the materials deposited in the General Refuse Area were likely a combination of commercial and industrial wastes (USEPA, 1987).

After 1978, the State of Indiana required disposal facilities to separate general refuse from the commercial and industrial wastes (i.e., the "separate area waste"). The approximate boundaries of the separate area waste deposits are shown on Figure 3-1. Prior to November 1980, EWC did not keep complete records of the volume and types of wastes accepted (USEPA, 1987).

On November 19, 1980, with the aid of a contract survey company, EWC began recording the placement of waste within the individual unlined waste areas (USEPA, 1987). Detailed locations of individual waste deposits within the unlined areas, and the respective dates of placement are shown in Figure 3-2. The actual dimensions of these units or cells were not recorded. These small waste management units or cells were dug and used on a daily basis (i.e., the "graveyard" method) until the "modified trench" method was adopted by the facility in the spring of 1985. According to information presented in the USEPA's Task Force Report (1987), the graveyard method involved digging a pit (unit) with dimensions of 20 feet by 20 feet by 15 feet (deep), placing the waste within the pit, and backfilling over the waste with excavated soil. The modified trench method was similar to the graveyard method, but individual pits were dug, as necessary, in a line that was called a "trench," and the waste in any unfilled pit was covered daily with soil. Therefore, with the modified trench method of disposal, only a small pit or waste management unit (RCRA landfill cell) was being used at any one time. Although the width of each trench varied and was generally not recorded, the trenches were typically excavated to a depth of approximately 15 feet (USEPA, 1987).

During a June 1986 inspection, the USEPA Task Force noted that EWC was engaging in the lateral expansion of the facility by excavating a new cell measuring 25 feet by 25 feet. According to Mr. James Wilkins, excavating cells and trenches one day prior to disposal was the normal practice for preparing to receive hazardous wastes (USEPA, 1987).

3.1.2 Lined Deposits

Cell A, a waste management unit with a flexible membrane and double-liner systems, was being constructed during the USEPA Task Force inspection in June 1986 (USEPA, 1987). Wastes were placed in this cell beginning on August 18, 1986. Cell A covers an area of approximately 300 feet by 500 feet and the bottom of the cell lies at approximately 760 feet amsl. The base

consists of two 80-ml, high-density, polyethylene (HDPE) synthetic liners separated by a drainage mesh that allows for the detection and collection of liquids that may be indicators of liner failure. A second drainage mesh, a permeable geotextile fabric, and 10 to 12 inches of sand are located between the double liner and the waste deposits and are used to facilitate the collection and removal of leachate (USEPA, 1987). Additional construction details are available in the most recent RCRA Part B Permit Application submissions (June 1987 and January 1988) and the "Closure and Post-Closure Plans" (April 13, 1989). It is assumed that Cell B and Cell C have similar design structures. The "area" method of waste disposal was used in the lined cells (Jacobs, 1988). This method consists of placing the waste in 3- to 5-foot lifts and covering the waste as it is "built out" into the cell. Because a portion of Cell C was constructed in an area that was previously landfilled, the older waste materials were probably excavated and replaced in the double-lined cells.

The leachate production records for Cells A-North, A-South, B, and C (Figure 3-1) were reviewed in an internal memorandum dated January 24, 1990 from Mr. Stephen Pekera of the IDEM Engineering Section to Dennis Zawodni of the IDEM Enforcement Section. Based on this review of graphical data, visual observations, and laboratory analyses of the leachate, IDEM concluded that leaks were present in all of the primary liner systems within the engineered cells. This information suggests the presence of a breach in the primary synthetic liner that allows leachate to infiltrate into the secondary leachate detection system.

3.2 Identification of Wastes

As indicated in the February 26, 1987 RCRA Part A Permit Application, the facility accepted RCRA wastes with heavy metals, wastewater treatment sludge, oven residues, petroleum refining wastes, steel mill emission control dust/sludge, lead smelting emission control dust/sludge, and corrosive materials (Table 3-2). According to the June 1987 RCRA Part B Permit Application,

the wastes accepted at the site were generally: (1) listed as hazardous because of the inorganic constituents (heavy metals) present, (2) characterized as hazardous because of corrosivity or Extraction Procedure (EP) Toxicity, or (3) classified as F001 through F005 wastes. Ignitable, reactive, or incompatible wastes were generally not accepted for disposal (EWC, RCRA Part B Permit Application, 1987).

Prior to acceptance and disposal of wastes in Cell A, greater than 90 percent of the wastes accepted for disposal were characteristically nonhazardous (EWC, RCRA Part B Permit Application, 1987); however, the specific methods used to determine hazardous characteristics were not well documented. It is likely that materials containing heavy metals were co-disposed with wastes containing high pH materials (i.e., lime-stabilized treatment residues). Waste was delivered both in bulk and in barrels (EWC, RCRA Part B Permit Application, 1987).

According to the June 1987 RCRA Part B Permit Application, wastes from the following general industrial categories were accepted for disposal at the landfill (not intended to be a complete listing):

- Electroplating and metal finishing operations,
- Steel manufacturers and fabricators,
- Foundries,
- Secondary lead smelters,
- Paint manufacturers and operations,

- o Government installations,
- o Commercial treatment and recovery facilities,
- o Chemical manufacturers, and
- o Miscellaneous general manufacturers.

Waste materials were transported to the site by contracted haulers and generators in tandem, triaxle semitractor/trailer units and roll-off boxes. The approximate daily average was 10 truckloads per day, but ranged between 0 and 50 loads per day depending on weather, scheduling, and other factors. Net load weights generally ranged from 16 to 22 tons, with gross weights up to the legal maximum (EWC, RCRA Part B Permit Application, 1987). Vehicles formerly entered the site from southeastern corner, stopping at a laboratory for check-in and on-site waste analysis before proceeding to individual cells for unloading. After June 1987, the office and laboratory were moved to the eastern parcel of property, across Indiana State Highway 17 (Figure 1-1). Loads were then weighed and examined at that location before proceeding across State Highway 17 onto County Highway 525 North, to the entrance of the northwest quadrant of the facility (Figure 2-1).

3.3 Corrective Measures

Organic contamination, detected primarily as a solvent odor, was encountered in a shallow sand seam within the Unit A till sequence (subunit A1) during the November 1988 installation of piezometer P-34A, located in the northwest quadrant (Figure 1-2). P-34A was constructed within the boundary of the General Refuse Area, an area of unlined deposits on the western margin of the site (Figure 3-1). The piezometer was sampled in November 1988, and elevated

levels of several VOCs (i.e., benzene; carbon tetrachloride; chloroform; and 1,2-dichloroethane) were detected in ground water. In November 1989, the same compounds were detected at higher concentrations, some above aqueous solubility. As a result, EWC performed a test excavation in November 1989 and piezometer P-34A was replaced with ~~installed~~ a large-diameter ground water recovery sump, ~~at the location of P-34A in November 1989.~~ Data collected during soil borings and piezometer/sump installation indicate that contamination within the perched water of subunit A1 was derived by lateral ground water flow from a proximal source within the General Refuse Area, rather than the vertical migration of VOCs through the Unit A till sequence (WW Engineering & Science, CAP Task II, 1991).

According to progress reports submitted by EWC to USEPA Region V (RCRA Enforcement), perched water was extracted from the sump between December 1989 and January 1991. As of November 6, 1990, approximately 277,000 gallons of perched water had been extracted from sump P-34A and transported off site for treatment. A sample of extracted water collected from sump P-34A in April 1990 contained benzene at 27 mg/L; carbon tetrachloride at 67 mg/L; chloroform at 10 mg/L; and 1,2-dichloroethane at 34 mg/L.

Two spill incidents leading to the deposition of waste materials off site were reported by EWC (GRA, CAP Task I, 1989). In May 1988, approximately 1/4 cubic yard of dust spilled from a truck on landfill property through the security fence and onto the right-of-way of State Highway 17. IDEM and the Indiana State Police were notified, and the spill was cleaned up immediately. Waste materials, including some sod and soil, were transported to the landfill for disposal (GRA, CAP Task I, 1989).

In June 1988, approximately 75 pounds of treatment sludge (F006) and a cubic yard of contaminated gravel were spilled from a truck at the intersection of County Highway 525 North and State Highway 17. IDEM was notified, the cleanup of the material was authorized, and the materials were transported to the landfill for disposal (GRA, CAP Task I, 1989).

4.0 NATURE AND EXTENT OF CONTAMINATION

Existing laboratory data were used to evaluate the nature and extent of contamination at the site and to develop RI tasks. However, some uncertainty exists because: (1) full copies of the original data reports and the associated quality assurance information are not available; (2) the existing data were collected during several separate sampling events and by several organizations (including IDEM, USEPA, and EWC); and (3) variables related to analytical methods, detection limits, laboratories, and sample handling and collection methods have not been assessed. Despite these limitations, certain data trends have remained consistent over time and can be used to direct the RI tasks.

4.1 Ground Water

As summarized in Section 2.5.2, several rounds of water level data measured by GRA in 1989 show a north to northeasterly ground water flow direction, with a very gentle horizontal gradient and a negligible vertical gradient. The data indicate that ground water in stratigraphic Unit A occurs in discontinuous, perched zones, and Unit B and Unit C act as a single, unconfined or partially confined aquifer. The Unit B and C water table elevations measured on November 30, 1989 were represented in the four generalized geologic cross sections (Figure 2-12 through Figure 2-15).

4.1.1 On-Site Well Sampling

Quadrant by quadrant summaries of the on-site ground water sampling data are provided in Table B-1 through Table B-4, included in Appendix B. These tables contain data associated with monitoring wells and piezometers screened in stratigraphic Units A, B, and C, and were compiled from a database generated at WW Engineering & Science in Grand Rapids, Michigan.

The data indicate that the wells and piezometers installed at the site were sampled over several different time periods for a variety of analytical parameters. The sampling points are shown on the general well location map (Figure 1-2). A detailed history of ground water monitoring at the site is included in GRA's "CAP Task I - Description of Current Conditions" report dated December 7, 1989, and a general overview is provided in this subsection.

Statistical failures with respect to contaminant indicators were primarily associated with pH in MW-20 and TOC in several downgradient wells, which resulted in RCRA assessment ground water monitoring during the period from 1985 to 1989. Data collected during this period are not consistent, and repeated analyses of volatile and semivolatile organic fractions did not confirm the presence of a ground water plume. For example, the May 1987 USEPA Task Force Report indicated the presence of hazardous waste constituents in three Unit A monitoring wells (MW-2, MW-5, and MW-7) and one Unit B monitoring well (MW-26). These constituents included 1,1-dichloroethane; chloroform; carbon tetrachloride; phenols; cresols; acetone; benzoic acid; toluene; trichloroethene, and naphthalene. In subsequent sampling events, several other constituents were detected in perched water samples collected from Unit A monitoring wells. These other constituents included: benzene; tetrachloroethene; bis(2-ethyl hexyl)phthalate; 1,2-dichloroethane; 1,1,2-trichloroethane; methylene chloride; carbon disulfide; nitrobenzene; and chloroethane.

Perched ground water samples collected within Unit A near some older areas of the landfill exhibited organic contamination. Although some organic compounds were detected in ground water samples from Unit B, these sample locations may have been affected during drilling activities by carry-down or cross contamination from Unit A. Concentrations of VOCs in the affected Unit B wells appeared to steadily decrease with each subsequent sampling event.

One Unit B well located in the northwest quadrant (MW-33B) showed consistent detections of the VOC 1,2-dichloroethane over time, with no indication of decreasing concentrations. Over the course of 11 sampling events between November 1988 and October 1990, this compound was detected at a maximum concentration of 1,100 μg/L. However, the analytical results of ground water samples obtained from monitoring wells and piezometers screened within Unit B along the northern and northeastern margins of the property (MW-31B, MW-30B, MW-23B, P-8B, and P-7B) did not indicate the presence of VOCs in the downgradient direction.

The compounds detected in perched water within subunit A1 near the P-34A sump area appear to be the result of the disposal of wastes containing VOCs within the General Refuse Area. The migration of VOCs beyond the limits of the General Refuse Area has likely resulted from lateral flow within a perched water zone that occurs in a shallow sand unit at the base of subunit A1. However, the A1 sand unit in the area of P-34A is separated from Unit B by approximately 25 to 30 feet of relatively impermeable glacial till assigned to subunits A2, A22, and A3 of the stratigraphic sequence.

In September 1989, IDEM collected a single round of samples from several Unit C piezometers and detected the following organic contaminants within this deeper unit (GRA, CAP Task I, 1989):

- Carbon disulfide, which is possibly of biogenic origin;
- 1,2-Dichloroethane;
- Tetrahydrofuran; and
- Diethyl ether.

4.1.2 Off-Site Well Sampling

The sampling and analysis of private water wells in the vicinity of the Four County Landfill began as early as 1981 (GRA, CAP Task I, 1989). In 1986, ISBH sampled domestic water wells near the landfill to address some of the citizens' concerns. Although some of these wells contained heavy metals and bacteria, the contamination at several residences was attributed to improper well construction or localized sources of contamination such as septic systems or feed lots (ATSDR, 1990).

Since October 1986, several residential wells have been sampled by Fulton County approximately twice a year, using a fund established by EWC. The laboratory data (without a description of the sampling or analytical procedures) have been reported to the Hazardous Substance Committee of the Fulton County Auditor's office by:

- Brookside Farms Laboratory Association, Inc. in Knoxville, Ohio between October 1986 and August 1987; and

- Environmental Health Laboratories in South Bend, Indiana beginning in March 1988.

Trace levels (less than 1 μg/L) of 1,2-dichloroethane have been detected in water samples from the well at the King Lake Baptist Church, located immediately northwest of the site (well #2 on Figure 2-11).

4.2 Soil

Field screening measurements obtained by using an HNu and the headspace technique suggest the presence of organic contamination in soil beneath the northern portion of the General Refuse Area. Detailed soil screening and analytical sampling have not been completed in other areas of the site.

4.3 Sediment and Surface Water

In August 1985, the ISBH collected sediment samples from King Lake for laboratory analyses of 18 pesticides, 17 polychlorinated biphenyls (PCBs), 13 metals, and cyanide. No organic compounds or cyanide were detected, and the metals detected in sediment fell within the range of normal background concentrations (GRA, CAP Task I, 1989).

During the 1986 USEPA Task Force investigation, four surface water samples were collected at the following locations:

- The inlet to the culvert beneath County Highway 525 North,
- The southwest retention pond,
- Runon at the southwest ditch, and
- Runoff from the southwest ditch.

Except for TOC and total organic halogens (TOX), most of the analytical concentrations detected in samples obtained from the southwest ditch were greater for the runoff than the runon. Several VOCs were detected in the southwest retention pond surface water sample, including toluene at 430 μg/L and 1,1,1-trichloroethane at 160 μg/L, as well as total chromium, lead, and mercury, TOC, TOX, total phenol, and ammonia. The surface water sample collected in the northeast quadrant at the NPDES outfall contained no significant concentrations of contaminants (USEPA, 1987).

As described in the USGS administrative report entitled "Assessment of the Geology, Ground-Water Flow, and Ground-Water Quality at Four County Landfill, Fulton County, Indiana" (Greeman, 1988), IDEM tabulated the results for four surface water samples collected at the NPDES discharge point in 1986 and 1987. Although no organic chemicals were found in three of these samples, one sample contained 17 VOCs detected at or above 100 μg/L (Greeman, 1988).

4.4 Air

In May 1988, Dr. Robert B. Jacko, Professor of Environmental Engineering at Purdue University, conducted an air emissions study of the landfill over an approximate 7-hour period, during a typical operating day (GRA, CAP Task I, 1989). Monitoring and analyses were conducted for suspended particulates, size distribution, particulate absorbed organics, vapor phase organics, and metals. In his November 1988 report, Dr. Jacko concluded that pollutants were either not detected or were present at concentrations many times lower than established allowable air standards. He also concluded that no pollutants exist in the ambient air downwind from the site that would compromise the health of individuals working or residing in the area.

4.5 Biota

As described in March 24, 1987 ISBH memorandum, the concentration of metals, total PCBs, pesticides, and pesticide degradation products in fish tissue samples collected from King Lake in August 1985 were below action levels established by the U.S. Food and Drug Administration.

Mr. Donald Steffeck of the USFWS's Indiana Field Office conducted a survey of contaminants in selected biota near the site during the summer of 1987. The report, which was released in October 1988, contains the analytical results for whole-body tissue samples of fish, anurans (frogs and tadpoles), crayfish, and small mammals (mice and shrews), including organochlorine chemicals, PCBs, and metals. Crayfish tissue was also analyzed for polynuclear aromatic hydrocarbons. All of the organisms were collected from areas receiving or potentially receiving surface water runoff from the site, and the analyte values were compared with those measured in organisms collected from a control area to the northeast of the landfill (Lake Maxinkuckee). The results of the study indicate the prevalence and concentration of inorganic analytes (i.e., heavy metals) may be statistically greater in tissue samples from biota collected from the wetland basin receiving flow from the NPDES outfall, and from the east-flowing, wooded drainageway to King Lake. Analytes specifically noted were manganese, aluminum, zinc, cadmium, mercury, and nickel. During the U.S. District Court hearing concerning the site, several expert witnesses were deposed by the defense to refute the conclusions of the USFWS study.

5.0 SITE STABILIZATION

As described in Section 3.0, the site includes three waste disposal cells (i.e., Cells A, B, and C) with leachate collection systems comprised of primary and secondary synthetic liners, sump pumps, and separate collection tanks for leachate generated in the primary and secondary collection systems. As requested by IDEM, the Participating Respondents have included site stabilization as part of this detailed SOW. The specific tasks involved in site stabilization are described in the following subsections.

5.1 Background

Available records regarding site maintenance, including leachate collection, surface water management, equipment, inspections, and personnel will be reviewed. Necessary improvements or modifications to the existing systems will be discussed with IDEM's Project Manager.

5.2 Deliverables

The Participating Respondents will provide the necessary personnel/contractors to continue operation and maintenance activities at the site. The following tasks are anticipated to be necessary components of the site stabilization effort:

- Collect, store, and dispose of leachate generated in landfill Cells A, B, and C. Consistent with current operations, the leachate level in each cell will be maintained to ensure that it does not exceed 1 foot above the primary liner. Leachate will be collected, manifested, transported, and disposed of at the Publicly Owned Treatment Works (POTW) located in the City of Kokomo,

Indiana, in accordance with applicable Federal, State, and local regulations.

- Pump surface water runoff that currently collects in Cell C to the northeast drainage control basin. If information suggests that the water collected in Cell C has come into contact with leachate, sampling and analysis may be required by IDEM. ~~Surface water runoff collected in the southwest retention pond will continue to be transferred to the northeast drainage control basin, as needed.~~

- Continue to transfer surface water runoff collected in the southwest retention pond to the northeast drainage control basin, as needed.

- Manage the northeast retention pond in accordance with the NPDES Permit, which has historically governed discharge from the pond. Although the NPDES Permit has expired, IDEM has determined that the permit conditions, including the sampling of discharge waters, will remain in effect. Sampling reports and analytical results will be submitted to IDEM. ~~The current status of the NPDES Permit, including ordinance and discharge limits, will require verification by IDEM.~~

- Provide maintenance for: (1) pumps, hoses, and storage tanks used in the management of leachate and surface water runoff; and (2) buildings and utilities at the site.

- Maintain the waste disposal areas by ensuring that areas of erosion are repaired and that any surface leachate seeps are identified and mitigated as quickly as practicable.

- Maintain current site security, utilities, and fuel for equipment. Maintain equipment used at the site belonging to the Participating Respondents.

- Perform a ~~site~~ landfill inspection ~~at a minimum frequency of once per week.~~ on a weekly basis, and after storms. ~~The~~ This inspection will include: (1) a determination that fencing and gates are in place and that utilities are operable, (2) a review of potential erosion, (3) an evaluation of the existing landfill cap, and (4) an assessment of the berms and the potential for ponding water or washouts. An inspection log will be completed and submitted to IDEM for review within 48 hours after each landfill inspection.

- Perform a daily site inspection to monitor the leachate collection and storage system. Inspect leachate storage area for leakage and deterioration of containers and dikes, including detection and storage tanks. Monitor and record the landfill leachate levels, and record the volume of leachate pumped from each cell (primary and secondary).

- Ensure that personnel involved in the site stabilization tasks are sufficiently trained and experienced in operating the equipment necessary for maintenance of site operations. This will include

certification that personnel have been trained in accordance with the 40-Hour Occupational Safety and Health Administration (OSHA) personal protection and safety regulations governing activities at hazardous waste sites.

6.0 REMEDIAL INVESTIGATION

As evidenced by information summarized in Sections 1.0 through 4.0, the Four County Landfill Site is not typical of numerous sites that undergo the RI/FS process because of the significant volume of data that has already been reported to IDEM and USEPA Region V. Much of the site background information, particularly with regard to the geologic setting and source characterization tasks, has already been collected. In addition, existing ground water data have been tabulated and summarized to allow a comparison to subsequently collected data. The following subsections address the primary RI tasks identified in IDEM's draft Statement of Work, including: scoping, site characterization, and a baseline risk assessment, as well as specific deliverables, including monthly progress reports. A preliminary identification of potential ARARs, remedial action objectives, and general response actions is also included in this section.

6.1 Scoping

6.1.1 Site Background

To the extent possible, the Participating Respondents are already fulfilling the requirements of this initial planning phase of the RI/FS. The Participating Respondents have investigated and defined the physical characteristics of the site (Section 2.0), and completed a detailed analysis of the waste accepted at the site and the history of disposal (Section 3.0). Historical site data, including documents, analytical results, maps, and communications have been obtained from a variety of sources, including:

- o IDEM and USEPA Region V,

- WW Engineering & Science,
- Former facility operators (site records),
- The Fulton County Auditor's Office,
- The IDNR Division of Water,
- The USEPA Environmental Monitoring Systems Laboratory,
- The U.S.G.S.,
- The Indiana Academy of Science,
- The Indiana Geological Survey, and
- The U.S. Department of Agriculture (Soil Conservation Service).

Historical information, particularly with respect to well installations and ground water analytical data, have been summarized and tabulated.

With approval from IDEM's Project Manager, representatives of the Participating Respondents conducted a site visit to become familiar with various aspects of the property on March 17, 1992. An orientation meeting was then held with the Four County Landfill Technical Committee on March 25, 1992.

On April 14 and May 18, 1992, representatives of the Participating Respondents held informal scoping meetings with IDEM staff to discuss the general technical approach of the proposed investigation. It is anticipated that additional meetings of this type will serve to facilitate general agreement between the Participating Respondents and IDEM and to permit the development of a SOW that addresses the RI/FS objectives. In this way, the document review process can be streamlined, and work can progress on the site in a timely manner.

As an additional site background task, the Participating Respondents retained Territorial Engineering in Walkerton, Indiana, to secure a current aerial photograph and a topographic map. The aerial photograph illustrates an approximate one-mile radius around the site, at a scale of 1 inch = 200 feet. A digitized contour map of the landfill area has been completed at a scale of 1 inch = 50 feet, with a 1-foot contour interval. To the extent possible, other digitized drawings and maps previously generated for the site will be obtained and used to develop the RI/FS Work Plan documents.

6.1.2 Project Planning

As part of the project planning task, the Participating Respondents will identify data needs, design a data collection program, and identify health and safety protocols. Before drafting the RI/FS Work Plan, the Participating Respondents will meet with IDEM to discuss the project-specific tasks, objectives, and deliverables.

6.1.3 Preliminary ARARs

The requirements of the Superfund Amendments and Reauthorization Act (SARA) regarding clean-up actions at CERCLA sites [Sections 121 (d)(1) and (2)] can be summarized as follows:

- The remedial actions selected must attain a degree of cleanup "which assures protection of human health and the environment," and

- When completed, the remedial actions selected must at least attain any "legally applicable or relevant and appropriate standards, requirements, criteria, or limitations."

The USEPA's "CERCLA Compliance with Other Laws Manual: Draft Guidance" (1988) was used to aid in the identification of preliminary ARARs for the site. Chemical-, location-, and action-specific preliminary ARARs are discussed in the following subsections.

6.1.3.1 Chemical-Specific Requirements

Chemical-specific requirements (i.e., technology- or risk-based numerical limitations or methodologies) are used to establish acceptable concentrations of chemicals that may be found at the site or discharged to the environment. The potential chemical-specific requirements for the Four County Landfill Site include: (1) drinking water maximum contaminant levels (MCLs), (2) non-zero maximum contaminant level goals (MCLGs), (3) Federal water quality criteria (FWQC), (4) IDEM chronic aquatic criteria, (5) POTW pretreatment standards, and (6) State and Federal NPDES regulations.

MCLs are the maximum contaminant levels that are allowed in water delivered to any user of a public water system and are the enforceable drinking water standards established by the USEPA under the Safe Drinking Water Act (SDWA). Pursuant to CERCLA Section 121 (d)(2)(A)(i), MCLs are potential ARARs because they are the enforceable requirements of the SDWA. According to the NCP, MCLs are generally considered an ARAR for ground water if MCLGs are not an ARAR and the MCLs are relevant and appropriate under the circumstances of the release.

MCLGs are nonenforceable goals for drinking water set by the USEPA under the SDWA. The MCLGs represent contaminant levels with no known or anticipated adverse effects on the health of persons, plus an additional margin of safety. Pursuant to the NCP [40 CFR 300.43 (e)(2)(i)(B)], where the MCLGs are determined to be relevant and appropriate under the circumstances of the release, non-zero MCLGs should be attained by remedial actions for ground water or surface water that is a current or potential source of drinking water. For a contaminant with an MCLG of zero, the MCL for that contaminant should be attained for current or potential sources of drinking water if the MCL is relevant and appropriate.

According to CERCLA Section 121(d)(2)(B) and the NCP, 40 CFR 300.430(e)(2)(i)(E), FWQC shall be attained if they are relevant and appropriate under the circumstances of the release. FWQC are nonenforceable guidelines for surface water set by the USEPA under the Clean Water Act (CWA) for the purpose of protecting human health and aquatic life. These quantitative levels of pollutants have been established to ensure that the water quality is adequate for a specified use. Whether FWQC are relevant and appropriate depends on the designated or potential water uses, the media affected, and the purposes for which the FWQC was developed. FWQC are used by states to set water quality standards for surface water, and by State and Federal Agencies for setting NPDES discharge permit levels. The goals of the FWQC are to protect: (1) humans from hazards associated with drinking contaminated water or consuming

aquatic organisms that live in contaminated water, and (2) aquatic life from acute and chronic exposure to pollutants.

The limits on industrial user discharges set by a local POTW are a potential ARAR if discharges to the POTW are a potential remedial alternative. Compliance with pretreatment regulations and standards developed by the POTW helps prevent the discharge of pollutants that pass through, interfere with, or are otherwise incompatible with the POTW. Because discharges to a POTW are considered in the initial screening of alternatives for the Four County Landfill Site, pretreatment regulations and standards set by the POTW are included as potential ARARs.

The MCLs and MCLGs are potential ARARs for monitoring: (1) the ground water at the site boundaries, and (2) the quality of treated leachate if it is injected into the aquifer. The FWQC are potential ARARs for the surface water in adjacent surface water bodies. The POTW pretreatment standards are potential ARARs if leachate is discharged to the POTW.

6.1.3.2 Location-Specific Requirements

Location-specific requirements are restrictions placed on the conduct of activities in particular locations. These ARARs relate to the geographical or physical position of the site rather than the nature of its contamination or the proposed remedial actions. Location-specific requirements may limit and/or impose additional constraints on the type of remedial action that can be implemented at a site.

Restrictions caused by floodplains and wetlands are among the most common location-specific requirements for municipal landfill sites. According to 40 CFR 6.302, remediation of a site located next to wetland areas and/or within a floodplain must be implemented in a manner that:

(1) minimizes the loss, destruction, or degradation of the wetland; and (2) preserves the natural and beneficial values of the floodplain. Table 6-1 presents potential location-specific ARARs.

6.1.3.3 Action-Specific Requirements

Action-specific requirements generally set performance, design, or other similar controls or restrictions on particular kinds of activities related to the management of hazardous substances. These requirements are triggered by the particular remedial activities that are selected to accomplish a remedy and are usually technology based. Table 6-2 presents potential action-specific ARARs.

6.1.4 Preliminary Remedial Action Objectives

The exposure routes of concern for the Four County Landfill Site will be identified in the Baseline Risk Assessment. Remedial action objectives will be defined based on the exposure routes of concern. However, based on current knowledge of the site, the following is a preliminary list of remedial action objectives:

- Ensure that ground water and surface water quality chemical-specific ARARs are met at the boundaries of the site,
- Minimize the potential for direct contact with on-site wastes, and
- Reduce leachate generation and secure appropriate leachate collection/disposal.

6.1.5 General Response Actions

The general response actions for remediation of the Four County Landfill Site will likely involve containing the landfill contents, controlling the production and migration of leachate in the landfill, and potentially controlling the migration of landfill gases.

This section identifies and screens technology types and process options that may be potentially used at the Four County Landfill Site. The guidance provided in USEPA's "Conducting Remedial Investigation/Feasibility Studies for CERCLA Municipal Landfill Sites" (1991) recognizes that for most CERCLA municipal landfills:

- The most practicable remedial alternative is containment,
- Extraction and treatment of leachate may be required to control off-site migration of wastes, and
- Constructing an active or passive landfill gas collection and treatment system may be necessary.

The following subsections provide an initial screening of the technologies and process options.

6.1.5.1 Landfill Contents

Access restrictions at landfills such as fencing and warning signs prevent and/or reduce direct exposure to the landfill contents. Deed restrictions prohibit and/or limit the site use or development and may be used alone or in combination with other remedial technologies.

6.1.5.2 Leachate Production, Minimization, and Control

Leachate in landfills is produced by the natural degradation of the landfill contents, surface water infiltration, and ground water migration through the landfill wastes. The production and potential migration or release of leachate into either surface water or ground water can be controlled by constructing horizontal and vertical barriers to prevent the direct contact of rain water and ground water with the landfill contents. Horizontal barriers such as caps are used to reduce surface water infiltration, improve erosion control, minimize odors, improve the site aesthetics, and control the production of landfill gas.

Capping usually requires surface grading and revegetation. Surface grading of covered landfill sites is an economical method of controlling infiltration, diverting runoff, supporting beneficial plant species, and maintaining the continued performance and reliability of a cap. Appropriate grading methods are dependent on site-specific conditions. Lower permeability imported or manufactured clay, with or without a chemical stabilizer or cement, can be used in constructing a cap.

Vertical barriers are used for containing, capturing, or directing ground water flow in the vicinity of the landfill. The vertical barriers that should be considered include upgradient barriers, or barriers that completely or partially surround the fill material at the site. Circumferential barriers can greatly reduce: (1) the amount of uncontaminated ground water entering the site from upgradient areas, and (2) the amount of contaminated leachate migrating away from the landfill. Based upon the site's subsurface stratigraphy and hydrogeology, grouted barriers formed by the pressure injection of special fluids into the soil may be applicable. However, grouted barriers are seldom used for containing ground water flow around large landfill sites because of their high cost.

Another vertical barrier option is a slurry wall, which is often more effective when coupled with a low permeability surface cap. Ideally, slurry walls are constructed to completely surround a landfill area and are keyed-in to a lower aquitard (impervious layer). In areas without a lower aquitard, partial penetrating slurry walls (i.e., slurry walls that are not keyed-in) can be used. Slurry walls are typically constructed of a soil/bentonite clay mixture.

Ground water extraction wells may also be used to provide a vertical hydraulic barrier to prevent or reduce direct contact between the upgradient ground water and the landfill contents. The effectiveness of this control technology is dependent on the number, spacing, and placement of the wells, screening intervals and pumping rates, and the hydrogeologic characteristics of the aquifer.

6.1.5.3 Leachate Collection, Treatment, and Disposal

Landfill leachate collection systems are used to collect leachate seepage before it discharges into the surface water or ground water. The most common leachate collection systems are subsurface drains and vertical extraction wells, which are generally installed along the side slopes of the landfill.

Subsurface drains used to intercept and direct leachate into a sump or wet well consist of underground gravel-filled trenches or perforated pipes. These drains are usually installed around the perimeter of the landfill base. Extraction wells can be placed within the landfill wastes or screened within the ground water aquifer. The well placement or screening interval depends on whether the intent is to capture the leachate, ground water, or both. Because leachate collection systems (i.e., subsurface drains) are widely used, they will be given further evaluation.

Landfill leachate is generally treated using conventional biological, chemical, and/or physical methods. The adopted treatment options depend on the characteristics of the leachate and can be conducted on site or off site at a POTW. The degree of treatment varies, depending on whether the effluent is to be discharged to a surface water body, injected into a deep ground water aquifer, or transferred to a POTW.

Chemical treatment methods include precipitation of metals by pH adjustment using chemicals such as lime, soda ash, or caustic. Biological treatment can involve aerobic (the most frequently used form of biological treatment) or anaerobic processes for treating high-strength organic wastes. Anaerobic treatment processes generate methane gas as a by-product and result in less sludge production than aerobic processes. ~~and methane gas as a by-product.~~

Physical treatment operations can involve air stripping and/or granular activated carbon adsorption of VOCs. Granular activated carbon is often employed as a polishing treatment step when very low contaminant discharge levels must be achieved. Organic compounds, such as phenols and chlorinated hydrocarbons, and heavy metals can be removed from a waste stream by using this treatment technology. Other physical treatment options, such as sedimentation and filtration, may also be employed as part of a general treatment system.

Finally, the landfill leachate may be discharged directly to a POTW for treatment.

6.1.6 Preliminary Remedial Alternatives

The following subsections present three potential appropriate remedial action alternatives for a landfill site. Alternative 1 is the no action alternative. Alternatives 2 and 3 consist of various methods of: (1) constructing a barrier that would reduce leachate production and minimize migration into the aquifer; (2) leachate collection, treatment, and disposal; (3) landfill gas

collection, treatment, and disposal; (4) monitoring of collected leachate, ground water, and surface water; (5) access restrictions; and (6) covering various portions of the landfill. The presence of both engineered (lined) cells and unlined deposits at the site may influence the remedial alternatives for a given area. Additional alternatives may be developed during the FS.

6.1.6.1 Alternative 1: No Action

Review of this alternative is required by the NCP. Under this alternative, no action would be taken at the site. Leachate generation and migration would continue, and the issue of landfill gas would not be addressed. Moreover, site access would not be further restricted. No costs would be incurred. A modification of this alternative would be institutional controls with no further action.

6.1.6.2 Alternative 2: Slurry Wall; Leachate Collection, Treatment, and Disposal; and Landfill Gas Collection, Treatment, and Disposal

This alternative involves the: (1) installation of a slurry wall as a vertical physical barrier; (2) leachate collection, treatment, and disposal; (3) landfill gas collection, treatment, and disposal; (4) monitoring of collected leachate, ground water, and surface water; (5) access restrictions; and (6) capping options.

The installation of a slurry wall would minimize the migration of leachate into the surficial aquifer. The wall would be installed beyond the farthest extent of the fill. The slurry wall would be keyed into the upper glacial till (e.g., stratigraphic subunit A3) separating water bearing zones in Unit A and Unit B. Ground water modeling may aid in the evaluation of the

various capping and slurry wall options. Given the presence of a double-liner system for the engineered cells, this may only be required in portions of the unlined disposal areas.

Leachate collection, treatment, and disposal are intended to eliminate the migration of leachate. A leachate collection system consisting of either extraction wells or subsurface drains would be constructed along portions of the landfill to intercept leachate migration. Leachate collection systems for the engineered cells are already in place and operating. Construction of any additional systems may only apply to the unlined deposits. Physical, chemical, or biological unit operations would be used alone or in combination as determined by treatability studies to treat the collected leachate prior to a surface water discharge. Because of its proximity to the site, discharge to the Kokomo POTW may be the preferable option. An evaluation of leachate flow rates and compatibility with POTW treatment processes will be completed during the remedial investigation.

Because landfill gas collection, treatment, and disposal may be necessary to prevent explosion hazards or to meet clean air regulations, trench vents and enclosed ground flares may be necessary. Ground water, surface water, and leachate would be monitored to evaluate the effectiveness of the chosen remedial action. Access restrictions, including deed restrictions, fencing, and warning signs, would also be implemented.

The capping options can be further subdivided with respect to the engineered cells and the unlined waste deposits. Capping options for the engineered cells would include:

- Repairing the existing cap,
- Upgrading the existing cap to a RCRA-equivalent cap, and

- o Installing a RCRA cap.

Capping options for the unlined deposits include:

- o Demonstrating that the existing cap is sufficient,
- o Upgrading to a subtitle D cap for the municipal waste deposits and a RCRA-equivalent cap for the unlined RCRA deposits, and
- o Installing a RCRA cap over both the municipal waste deposits and the unlined RCRA deposits.

6.1.6.3 Alternative 3: Hydraulic Barrier; Leachate Collection, Treatment, and Disposal; and Landfill Gas Collection, Treatment, and Disposal

This alternative consists of: (1) constructing a subsurface hydraulic barrier; (2) leachate collection, treatment, and disposal; (3) landfill gas collection, treatment, and disposal; (4) monitoring for collected leachate, ground water, and surface water; (5) access restrictions; and (6) capping options.

The subsurface hydraulic barrier is intended to minimize the further migration of leachate into the aquifer and could consist of a series of shallow extraction wells beyond the margins of the landfill. As with Alternative 2, this may be required only for the unlined areas due to the existence of the double-liner system beneath the engineered cells. Ground water modeling may aid in the evaluation of the various hydraulic barrier design scenarios and capping options.

The other technologies (i.e., leachate and landfill gas collection, treatment, and disposal; monitoring; access restrictions; and capping options) included in Alternative 3 are the same as described for Alternative 2.

6.1.7 Deliverables

~~The information contained in Sections 1.0 through 4.0 of this document will be expanded or modified as necessary to generate the Preliminary Evaluation Summary described in the IDEM draft Statement of Work.~~ Pertinent portions of the site background information (i.e., Sections 1.0 through 4.0 of this document) will be included as the Preliminary Evaluation Summary ~~an individual~~ section in the RI/FS Work Plan. At the conclusion of the project planning phase, the Participating Respondents will submit an RI/FS Work Plan, a Sampling and Analysis Plan (SAP) ~~a Field Sampling Plan (FSP)~~ that will include a Field Sampling Plan (FSP) ~~Sampling and Analysis Plan (SAP)~~ and a Quality Assurance Project Plan (QAPP), a Health and Safety Plan (HSP), an Environmental Evaluation Plan, and a schedule for implementation of tasks and deliverables. As described in Section 6.3.2, the environmental evaluation will consist of a separate report to summarize existing, published information pertaining to the Four County Landfill Site.

The RI/FS Work Plan as well as the supporting plans will be prepared and contain details consistent with the guidance documents and additional requirements specified in the Agreed Order negotiated between the State of Indiana and the Participating Respondents. At the conclusion of the scoping task, draft copies of the plans will be submitted to IDEM for review and comment. No field work governed by the plans will be initiated at the site prior to the approval of the Work Plan, FSP, and QAPP. In addition, the Participating Respondents understand that IDEM will review (rather than approve) the HSP.

6.2 Site Characterization

The overall objectives of the site characterization will be to confirm and complete an evaluation of the nature and extent of contamination (Section 4.0), and to describe areas of the site that may pose a threat to human health or the environment. Individual tasks associated with completing site characterization, which will be further described in the RI/FS Work Plan, FSP, and QAPP, will be designed to meet quality assurance/quality control and data quality objectives. The site characterization task will proceed in a phased manner based on the results of previous investigations at the site and any preceding tasks. In this manner, each task can be modified as necessary to maximize data quality while progressing toward remediation in a cost-effective and technically sound manner. Based on a review of the available site background information, additional site characterization data described in the following subsections should be collected to better define the eventual remedial alternative.

6.2.1 Field Investigations

6.2.1.1 Preparation and Mobilization

Field support activities will be initiated following the approval of the Work Plan and SAP, and may include: (1) obtaining access to sample locations; (2) scheduling; and (3) procuring required equipment, office space, laboratory services, and/or contractors. IDEM will be notified at least two weeks prior to initiating field support activities (to ensure adequate scheduling of oversight tasks) and upon the completion of field support activities.

6.2.1.2 Source Characterization

Defining the source of contamination will include analyzing the potential for contaminant release (e.g., long-term leaching from soil), contaminant mobility and persistence, and characteristics important for evaluating remedial actions, including information to assess the containment of a closed or partially closed hazardous waste landfill site.

The Participating Respondents will complete a detailed analysis of the existing waste disposal information and tabulate the associated physical and/or chemical characteristics. A characterization of waste types, the timing of their receipt, and the associated disposal methods as they relate to the findings of the site investigation will be conducted during the RI. Available information regarding the construction specifications (as-builts) of the engineered Cells A, B, and C will be summarized.

6.2.1.3 Sediment and Surface Water Investigation

Proposed sediment sampling points for 8 on-site locations and 12 off-site locations are indicated on Figures 6-1 and 6-2, respectively. Grab samples will be analyzed for the organic compounds on the USEPA's Target Compound List (TCL) and the inorganic analytes on the USEPA's Target Analyte List (TAL). If surface water is present at any of the proposed locations, samples will be collected and analyzed for the same suite of contaminants. The following general locations are proposed:

On Site

- At the northeast drainage control basin, samples will be collected from one location near the northwestern pier and four additional locations near the sides of the basin.

- In the low, swampy area near the NPDES discharge point, a total of two representative samples will be collected.

- One sample will be taken within the southwest retention pond.

Off Site

- In the wetland basin located north of County Highway 525 North, samples will be obtained from one location immediately adjacent to the culvert opposite the NPDES outflow and two additional, representative locations.

- One sample will be collected near the upgradient (western) side of a culvert beneath County Road 1000 West that allows water to drain to the wetland basin north of the site.

- Three samples will be obtained in the open area to the west of the landfilled property.

- Two samples will be taken from the drainageway running onto the property from the south, at locations far enough upgradient to avoid the potential influence from a backup of the southwest retention pond.

- Samples will also be obtained at three points along the wooded drainageway leading from the eastern side of State Highway 17 toward King Lake, including: (1) near the eastern side of State Highway 17, (2) near the western side of old State Road 17, and (3) one representative location between these two end points.

6.2.1.4 Well Abandonment

The wells and piezometers proposed for abandonment include:

- Those monitoring wells or piezometers with unreasonably long effective screen lengths (i.e., well screen plus filter pack) that would facilitate a hydraulic connection between distinct geologic layers; and

- Those wells with improper construction specifications relative to existing standards.

The 25 wells and piezometers proposed for abandonment are listed in Table ~~6-1~~ 6-3, and the locations are shown in the general well location map (Figure 1-2). Wells and piezometers will be abandoned consistent with State regulations (310 IAC 16-10-2). A justification and

explanation for the wells being considered for abandonment will be included in the Preliminary Evaluation Summary section of the RI/FS Work Plan.

6.2.1.5 Ground Water Investigation

As part of the initial RI/FS field investigations, an inspection and inventory of the existing site wells will be completed. The condition of the well casings above ground, protective covers, locks, and cement/bentonite surface grout will be noted.

A total of 71 ~~Some of the~~ existing wells and piezometers (i.e., ~~those~~ ground water sampling points with reasonable screen lengths and construction specifications) ~~installed in stratigraphic Units A, B, and C~~ will be sampled as part of the first phase of the site characterization. The proposed sample points in this initial monitoring program (Table ~~6-2~~ 6-4) include wells screened in stratigraphic Units A, B, and C, extending to the more permeable subunit C2. In general, wells installed below subunit C2 will not be abandoned, but retained for future use, depending on the results of the initial round of ground water sampling. ~~if required.~~ The general locations of wells and piezometers are shown on Figure 1-2.

Water level and total depth measurements will be obtained for each sampling point, and a photoionization detector (PID) will be used to screen for the presence of VOCs at the well head. A minimum of three times the volume of water standing in the well or piezometer casing will be removed during the purging process, and measurements of temperature, pH, and specific conductivity will be recorded to confirm aquifer stabilization.

The final list of ground water analytical parameters will be specified in the RI/FS Work Plan. While determining the extent and magnitude of contamination attributable to the site (the RI/FS), the Participating Respondents will analyze ground water samples ~~will be analyzed~~ for TCL

VOCs, TCL semivolatile organic compounds (SVOCs), TAL dissolved metals, TAL total cyanide, and the following landfill leachate indicator parameters:

- o pH,
- o Sulfate,
- o Chloride,
- o Nitrate,
- o Ammonia,
- o Total dissolved solids (TDS),
- o Total suspended solids (TSS), and
- o Alkalinity.

The analyses of these organic and inorganic parameters will allow for a thorough evaluation of potential impacts from the landfill materials. After identifying the extent of any ground water plume from the site, samples will be collected from the monitoring wells located within this plume, and analyzed for all hazardous waste constituents (Appendix IX parameters), as well as biological oxygen demand (BOD) and chemical oxygen demand (COD), in support of potential treatability studies and an evaluation of potentially feasible remedial technologies.

After reviewing the available well construction data in greater detail, a list of monitoring wells and/or piezometers suitable for analysis of in-situ permeability testing will be determined. The proposed test locations will be chosen from a geographically and stratigraphically representative group of Unit B and C wells. Slug tests will be performed with a computerized data logger to measure rapid changes in water levels, and evaluated by using appropriate analytical methods.

~~Analytical data for private water wells sampled by Fulton County during the period extending from 1986 to 1992 will be reviewed, summarized, and placed in context with the on site analytical data to determine whether the existing monitoring system is sufficient to characterize the nature and extent of ground water contamination and the potential threat to human health and the environment.~~ Since the extent and magnitude of a contaminant plume attributable to the Four County Landfill has not been established, it is not possible to determine which off-site wells could potentially have been impacted by the site. If an off-site plume attributable to the Four County Landfill is delineated, those residential/off-site wells which are potentially within this plume will be evaluated to determine if the site has impacted the wells. This evaluation will include an assessment of well construction, depth, historical sampling and analytical data, as well as possible re-sampling. If the installation of additional monitoring wells or the sampling of private water wells is deemed to be a technically sound RI task, then a specific plan to present the objectives and details of such a program will be submitted to IDEM and USEPA Region V for review and approval.

6.2.2 Data Analysis, Validation, and Interpretation

Surface water, sediment, and ground water samples collected during the field investigations will be analyzed by a qualified laboratory and independently validated. Analysis of data collected for site characterization will meet the data quality objectives developed in the approved QAPP

or revised during the RI. These data will be presented in an appropriate format for interpretation and review.

6.2.3 Data Management

Pursuant to the SAP, information gathered during site characterization will be documented and adequately recorded in field logs and laboratory reports. Sample management and tracking will be maintained according to the SAP.

6.2.4 Deliverables

The Participating Respondents will prepare a draft RI report that summarizes: (1) the results of the site characterization, (2) the source of contamination, (3) the nature and extent of contamination, and (4) the fate and transport of contaminants. The draft RI Report will include a Baseline Risk Assessment of the site (Section 6.3) and provide a basis for evaluating appropriate remedial alternatives (Section 7.2). The document will be submitted to IDEM for review and comment, and a final RI report will be prepared that addresses IDEM's review comments.

6.3 Baseline Risk Assessment

6.3.1 Human Health Risk Assessment

The Participating Respondents will identify and document the contaminants detected during site investigations, complete an assessment of the potential exposure to these contaminants, develop

and document a toxicity assessment, and characterize risks associated with these exposures. The document will be prepared taking into account the following guidance documents and databases:

- Superfund Public Health Evaluation Manual (SPHEM),
- Superfund Exposure Assessment Manual (SEAM),
- Integrated Risk Information System (IRIS), and
- Public Health Risk Evaluation Database (PHRED).

In addition, the following USEPA documents from the Risk Assessment Guidance for Superfund (RAGS) Volume I may be utilized during the RI/FS process:

- Part A - Human Health Evaluation Manual (Interim Final, December 1989);
- Part B - Development of Risk-Based Preliminary Remediation Goals (Interim Final, December 1991); and
- Part C - Risk Evaluation of Remedial Alternatives (Interim Final, December 1991).

6.3.2 Environmental Evaluation

A separate Environmental Evaluation Report will be prepared and will include a listing of any: (1) critical habitats, and (2) endangered species or habitats of endangered species. The Environmental Evaluation Report will take into account the following documents:

- RAGS Volume II - Environmental Evaluation Manual (Interim Final, March 1989); and

- Region V Scope of Work for Ecological Assessment (April 30, 1991).

The Environmental Evaluation Report will summarize the existing, published information pertaining to the Four County Landfill Site, including: (1) a description of the site's physical conditions, (2) a listing of critical habitats and endangered species, (3) a toxicity assessment of site contaminants, and (4) an assessment of the potential for adverse ecological effects from exposure to the contaminants. A full toxicological assessment of flora and fauna will not be performed unless data collected during the RI/FS indicate that such a study is necessary.

6.3.3 Deliverables

The draft RI Report will include a draft Baseline Risk Assessment for review and comment by IDEM, and the final RI Report will be prepared to address IDEM's comments on the draft Baseline Risk Assessment. The Environmental Evaluation Report will be submitted as a separate document to IDEM, and a final version will be prepared to address review comments.

6.4 Monthly Progress Reports

Monthly progress reports will be prepared to describe the technical progress of the RI/FS. These reports will contain the following information:

- Status of work and progress made to date,
- Percentage of work completed and the status of the schedule,
- Difficulties encountered and corrective actions to be taken,
- Deviations from the schedules provided in the RI/FS Work Plan,
- The activities and progress,
- Activities planned for the next reporting period, and
- Any changes in key project personnel.

7.0 FEASIBILITY STUDY

The Participating Respondents will provide IDEM with sufficient information to permit the selection of a site remedy. This information will consist of evaluating treatability studies, developing and screening remedial alternatives, and providing a detailed analysis of selected remedial alternatives.

7.1 Treatability Studies

The need for and extent of treatability studies (e.g., evaluation of cover materials) will be evaluated during the scoping and site characterization tasks for the RI/FS. Potential candidate treatability studies will be identified during the scoping phase (Section 6.1) of the RI/FS and discussed in the Work Plan. In this manner, the data gathering efforts conducted during the site characterization activities (Section 6.2) can be refined to ensure that sufficient information is collected to support the anticipated treatability studies. If it is determined that treatability testing is required, a Treatability Testing Work Plan will be submitted to IDEM for review and approval.

7.2 Development and Screening of Remedial Alternatives

The initial report prepared as part of the FS process will be an Alternatives Array Document (AAD) that presents the appropriate remedial alternatives for containment of a closed or partially closed hazardous waste landfill site. This document will contain a discussion of the specific remedial action objectives, general response actions, anticipated areas/volumes of affected media that require remediation, the initial screening of remedial technologies, and an assembly of appropriate technologies into remedial alternatives. The preliminary ARARs and remedial alternatives identified during the scoping phase (Section 6.1) will be reviewed, and modified if

necessary, in the AAD. The AAD will be submitted to IDEM for review and comment; this deliverable and IDEM's comments will provide the basis for a detailed analysis of remedial alternatives.

7.3 Detailed Analysis of Remedial Alternatives

The major effort conducted as part of the FS for the site will be a detailed analysis of the applicable remedial alternatives identified in the AAD that are appropriate for further analysis and review. Each alternative will be evaluated with respect to the following criteria:

- Overall protection of human health and environment;
- Compliance with ARARs;
- Long-term effectiveness and permanence;
- Reduction of toxicity, mobility, or volume of materials;
- Short-term effectiveness;
- Implementability;
- Cost;
- USEPA acceptance; and
- Community acceptance.

The alternatives will be compared with respect to the relative satisfaction of each of the aforementioned criteria in a draft FS Report, which will be prepared for IDEM's review and approval. After IDEM's comments have been addressed, the Participating Respondents will prepare the final FS Report for submittal to IDEM.

7.4 Monthly Progress Reports

Consistent with the format described in Section 6.4, monthly progress reports will be prepared and submitted to IDEM during the FS.

TABLE 1-1

LIST OF SUBSTANTIVE DOCUMENTS
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA
(Page 1 of 7)

Date	Title/Reference	Prepared by/Submitted by	Prepared for
June 21, 1972	"Engineering Report - Proposed Commercial Sanitary Landfill Project"	Joseph L. Tite, P.E.	Avery L. Wilkins
March 13, 1973	Notice to Cease and Desist	Dean K. Stinson, M.D. C.I. Newman Indiana State Board of Health (ISBH)	Avery L. Wilkins
November 11, 1980	Resource Conservation and Recovery Act (RCRA) Part A Permit Application	Environmental Waste Control, Inc. (EWC)	U.S. Environmental Protection Agency (USEPA) Region V
June 23, 1983	"Ground Water Study and Monitoring Well Installation"	Dibakar Sundi and John W. Weaver of Salisbury Engineering, a division of ATEC Associates, Inc. (ATEC)	EWC
January 31, 1984	RCRA Part B Permit Application	EWC	USEPA Region V ISBH
November 1, 1984	"Program Proposal - Ground Water Quality Assessment Plan"	Walter W. Grimes of ATEC	ISBH Division of Land Pollution Control
July 1985	Agreed Order for a Ground Water Assessment Plan (GWAP) - Cause No. N-128	Indiana Environmental Management Board	EWC
August 21, 1985	"Revised Submittal - Ground Water Assessment Plan (GWAP)"	John W. Weaver of ATEC	EWC
December 31, 1985	RCRA Part B Permit Application (Revision)	EWC	USEPA Region V
September 24, 1986	National Pollutant Discharge Elimination System (NPDES) Permit No. IN 0048097	Indiana Department of Environmental Management (IDEM) Office of Water Management	EWC

TABLE 1-1

LIST OF SUBSTANTIVE DOCUMENTS
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA
(Page 2 of 7)

Date	Title/Reference	Prepared by/Submitted by	Prepared for
October 21, 1986	Notice of Inadequacy regarding RCRA ground water inspection (Cause No. N-128)	Thomas Russell of IDEM's *Enforcement Section*	Stephen Shambaugh of EWC
November 7, 1986	"Task 1 - Data Compilation and Review Summary, Regulatory Compliance Evaluation, and Hydrogeological Assessment"	Glenn D. Martin and Richard K. Hosfeld of Dames & Moore	Michael Johnson of Advanced Waste Management, Inc. (AWM)
February 26, 1987	RCRA Part A Permit Application (Revision)	EWC	IDEM
March 24, 1987	King Lake sediment and tissue analysis results from August 1985 (Internal Memorandum)	Nancy A. Maloley of IDEM	John Winters of IDEM
April 24, 1987	"Hydrogeologic Assessment Report" (Draft)	Glenn D. Martin and Richard K. Hosfeld of Dames & Moore	Four County Landfill
May 1987	"Study Plan - A Survey for Contaminants in Selected Biota Near the Four County Landfill"	Donald W. Steffeck of U. S. Fish and Wildlife Service (Bloomington, Indiana Field Office)	USEPA Region V IDEM ISBH Agency for Toxic Substances and Disease Registry (ATSDR)
May 1987	"Hazardous Waste Ground-Water Task Force Evaluation of the Four County Landfill, Fulton County, IN"	Joseph J. Fredle of USEPA Region V IDEM	
May 29, 1987	"Addendum I to the Four County Landfill Hydrogeologic Assessment Report" (Draft)	James S. Flickinger, Richard K. Hosfeld, and Jeff Steiner of Dames & Moore	EWC

TABLE 1-1

LIST OF SUBSTANTIVE DOCUMENTS
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA

Date	Title/Reference	Prepared by/Submitted by	Prepared for
June 5, 1987	"Geologic Setting of the Four County Landfill, Fulton County, Indiana"	John Bassett of Geosciences Research Associates, Inc. (GRA)	EWC
June 17, 1987	"Hydrogeologic Assessment Report" (Revision)	Dames & Moore	AWM
June 30, 1987	RCRA Part B Permit Application (Revision)	EWC AWM Regional Services Corporation (RSC) Resources Unlimited, Inc. (RUI) George Pendygraft of Baker & Daniels	IDEM
September 30, 1987	"Fact Sheet - Intent to Deny a RCRA Operating Permit"	IDEM USEPA Region V	Public
January 11, 1988	"Geologic Interpretation of the Four County Landfill Area" (Memorandum Report)	John Bassett of GRA	Richard J. Wigh of RSC
January 12, 1988	"Hydrogeologic Assessment Report" (Final)	Richard K. Hosfeld and Fred W. Erdmann of Dames & Moore	Stephen Shambaugh of EWC
January 18, 1988	Comments and Supplemental Information for the RCRA Part B Permit Application	EWC AWM RSC RUI George Pendygraft of Baker & Daniels	IDEM
January 27, 1988	"Comprehensive Monitoring Evaluation" (CME)	Dean Geers and Chris Williams of Jacobs Engineering Group Inc.	USEPA Region V IDEM

TABLE 1-1

LIST OF SUBSTANTIVE DOCUMENTS
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA

Date	Title/Reference	Prepared by/Submitted by	Prepared for
April 1988	"Site Analysis - Four County Landfill, Fulton, Indiana"	Douglas J. Norton of USEPA's Environmental Monitoring Systems Laboratory	USEPA Region V
June 1, 1988	"Groundwater Monitoring Plan"	EWC RSC AWM	Robert Autio of IDEM's Geology Section
October 1988	"A Survey for Contaminants in Selected Biota Near the Four County Landfill, Fulton County, Indiana"	Donald W. Steffeck of the U.S. Fish and Wildlife Service (Bloomington, Indiana Field Office)	ATSDR
November 1988	"Assessment of the Geology, Ground-Water Flow, and Ground-Water Quality at Four County Landfill, Fulton County, Indiana"	Theodore K. Greeman of the U.S. Geological Survey	ATSDR
November 28, 1988	"Groundwater Flow Patterns Near the Four County Landfill - A Preliminary Assessment"	Henk Haitjema of Haitjema Consulting, Inc.	Supporters to Oppose Pollution (STOP)
November 30, 1988	"Ambient Air Measurements at Four County Landfill"	Robert B. Jacko	George Pendygraft of Baker & Daniels
March 1989	Judicial Decree for a RCRA Facility Investigation (RFI) Corrective Action Plan (CAP)	U.S. District Court USEPA	EWC
April 13, 1989	"Closure and Post-Closure Plans"	RSC	USEPA Region V IDEM

TABLE 1-1

LIST OF SUBSTANTIVE DOCUMENTS
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA
(Page 5 of 7)

Date	Title/Reference	Prepared by/Submitted by	Prepared for
April 28, 1989	"Implementation of Ground Water Monitoring Plan at EWC Four County Landfill" (Memorandum Report regarding 1988 and 1989 investigations)	John Bassett of GRA	George Pendygraft of Pendygraft & Plews
September 1989	"CAP Task I - Description of Current Conditions" (Draft)	GRA EWC	IDEM USEPA Region V
November 15, 1989	"Work Plan for Soil Boring and Piezometer Installation-Phase II, Interim Corrective Measure Investigation"	GRA EWC	Jonathan Adenuga of USEPA Region V
November 15, 1989	"Health and Safety Plan - Phase II"	AWM EWC	Jonathan Adenuga of USEPA Region V
December 7, 1989	"CAP Task I - Description of Current Conditions" (Final)	GRA EWC	IDEM USEPA Region V
December 15, 1989	"P-34A Corrective Measure Investigation" (Memorandum Report)	John Bassett of GRA	Stephen Shambaugh of EWC
December 21, 1989	"Piezometer 34A Subsurface Exploration" (Final Report)	Michael Johnson of AWM Steve Cecil of EWC	IDEM USEPA Region V
January 24, 1990	"Four County Landfill Analysis of Primary Liner Condition for Cells A-North, A-South, B, and C" (Internal Memorandum)	Stephen Pekera of IDEM Engineering Section	Dennis Zawodni of IDEM Enforcement Section
January 31, 1990	"RFI of Corrective Actions - CAP Task VI (Parts A, B, and C)"	WW Engineering & Science Steve Cecil of EWC	USEPA Region V

TABLE 1-1

LIST OF SUBSTANTIVE DOCUMENTS
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA

Date	Title/Reference	Prepared by/Submitted by	Prepared for
March 1, 1990	"1989 Annual Groundwater Report"	RSC	USEPA Region V IDEM
April 12, 1990	"GWAP" (Revised from a September 1989 version)	Richard J. Wigh of RSC Stephens Shambaugh of EWC	IDEM USEPA Region V
April 13, 1990 to July 19, 1991	Progress Reports - CAP Task V(B) and Task VIII	Steve Cecil of EWC	Jonathan Adenuga of USEPA Region V, RCRA Enforcement Branch
July 26, 1990	"Final Health Assessment for Four County Landfill"	Louise Fabinski, Joseph L. Hughart, and Kenneth Orloff of the ATSDR	Public Request from Senators Lugar and Quayle
October 10, 1990	GWAP Modifications (letter revision of 4/12/90 version)	Kathy Prosser of IDEM	Stephen Shambaugh of EWC
October 12, 1990	"Four County Landfill Fact Sheet," Document Number 00150573	Katten, Muchin & Zavis, Special Environmental Counsel	EWC bankruptcy estate
December 17, 1990	"Four County Landfill Detailed Preliminary Waste-In"	Unknown	Unknown
March 11, 1991	"RFI Work Plan - CAP Task II," including a Project Management Plan, a QAPP, a Data Management Plan, a Health and Safety Plan, a Community Relations Plan, and an Airborne Contamination Work Plan and QAPP	WW Engineering & Science EWC	IDEM USEPA Region V
February 14, 1992	Special Notice Letter, Draft Agreed Order for a RI/FS, and Draft Statement of Work	IDEM	Participating Respondents

TABLE 1-1

LIST OF SUBSTANTIVE DOCUMENTS
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA

Date	Title/Reference	Prepared by/Submitted by	Prepared for
April 21, 1992	Good Faith Offer letter and Technical Memorandum	Four County Landfill Site Steering Committee and Technical Committee Environmental Resources Management-North Central, Inc. (ERM-North Central)	Catherine Daugherty and Paul Courtney of IDEM

TABLE 2-1

SOIL CHARACTERISTICS OF THE UNIT A TILL SEQUENCE[1]
FOUR COUNTY LANDFILL
FULTON COUNTY, INDIANA

Boring Identification	Sample Depth (feet bgs)	Dry Density (pcf)	Natural Water Content (percent)	Permeability[2] (cm/sec)	USDA Classification	Unified Soil Classification[3]
P-1	8 - 10	124.2	15.8	9.6×10^{-8}	Loam[4]	CL/ML[4]
P-1	24 - 26	136.7	10.6	9.6×10^{-8}	Silty clay[4]	CL[4]
P-2	26 - 28	127.1	15.1	2.4×10^{-8}	Silty clay[4]	CL[4]
MW-25	8 - 10	122.5	18.7	1.3×10^{-7}	Loam[4]	CL[4]
MW-25	32 - 34	132.1	17.0	6.2×10^{-8}	Silty clay[4]	CL[4]
MW-26	8 - 10	132.3	14.7	1.2×10^{-6}	Clay loam[4]	ML[4]
MW-26	28 - 30	128.5	16.3	1.3×10^{-7}	Clay loam[4]	CL/ML[4]
MW-24S	6 - 8	138.3	12.8	7.0×10^{-7}	Sandy loam	SM
MW-28S	24 - 26	127.0	14.6	2.3×10^{-7}	Silty clay loam	ML
MW-28S	30 - 32	127.7	12.8	7.3×10^{-6}	Silt loam	CL/ML
MW-28S	43 - 45	131.4	11.1	1.3×10^{-5}	Silt loam	CL/ML

Notes:

[1] Modified from Table 3 of the January 12, 1988 "Hydrogeologic Assessment Report" by Dames & Moore. Raw data collected between 1986 and 1987.

[2] Falling head permeability tests performed on Shelby tube soil samples.

[3] Unified Soil Classification designations are as follows:
CL = Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays;
ML = Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity; and
SM = Silty sands, sand-silt mixtures.

[4] Based on visual inspection.

Key:

bgs = Below ground surface.
pcf = Pounds per cubit foot.
USDA = U.S. Department of Agriculture.

TABLE 2-2

SOIL CHARACTERIZATION DATA FROM 1988 AND 1989 INVESTIGATIONS[1]
FOUR COUNTY LANDFILL
FULTON COUNTY, INDIANA
(Page 1 of 2)

Stratigraphic Unit Sampled[2]	Boring Identification	Sample Depth (feet bgs)	Texture (Percent Finer)								Atterberg Limits			Soil Classification	
			Sieve					Hydrometer							
			#4, 4.75 (mm)	#10, 2.00 (mm)	#35, 0.50 (mm)	#120, 0.125 (mm)	#200, 0.074 (mm)	0.050 (mm)	0.005 (mm)	0.002 (mm)	LL (percent)	PL (percent)	PI	USDA	Unified[2]
Subunit A1	24 B	10.0 - 12.0	97.7	92.0	86.6	71.8	66.7	62.0	27.0	19.5	24.5	14.2	10.3	Loam	CL
	28 B	22.0 - 25.5	95.5	89.7	80.2	65.0	60.4	54.5	22.0	14.9	25.5	15.4	10.1	Loam	CL
	32 B	12.0 - 14.0	96.3	92.0	85.2	66.2	60.3	54.0	22.0	14.5	21.8	13.9	7.9	Loam	CL
Subunit A2	24 B	17.2 - 20.0	100.0	96.5	93.6	88.8	85.8	81.5	37.0	24.0	26.7	16.6	10.1	Silt loam	CL
	25 A	10.0 - 12.0	97.4	94.7	90.9	83.8	79.5	75.5	30.5	19.9	26.0	16.4	9.6	Silt loam	CL
	28 B	28.0 - 30.0	99.2	96.7	93.3	87.8	84.1	78.0	32.5	22.0	24.2	15.4	8.8	Silt loam	CL
	32 B	20.0 - 22.0	98.7	97.0	93.6	86.9	83.3	78.0	34.5	22.5	26.8	15.7	11.1	Silt loam	CL
Subunit A22	24 B	22.0 - 24.0	97.3	91.8	84.4	62.8	57.3	52.5	25.0	15.5	23.9	14.3	9.6	Loam	CL
	25 A	22.0 - 24.0	94.6	89.6	81.2	58.9	52.8	49.5	19.5	14.0	17.6	13.0	4.7	Loam	CL-ML
	28 B	36.0 - 38.0	92.8	88.4	81.4	61.6	55.3	50.5	19.5	13.0	20.2	12.9	7.3	Loam	CL
	32 B	30.0 - 32.0	90.8	86.0	78.6	56.3	50.1	45.0	18.5	12.0	17.5	11.9	5.6	Loam	CL-ML
Subunit A3	24 B	46.0 - 48.0	97.6	94.2	91.5	85.5	83.1	79.0	28.5	18.0	24.9	16.0	9.0	Silt loam	CL
	25 A	34.0 - 36.0	98.8	95.6	91.4	72.5	65.4	61.0	21.0	13.0	18.7	12.7	6.0	Silt loam	CL-ML
	28 B	46.0 - 48.0	97.4	93.6	89.5	72.0	65.3	59.0	20.0	12.0	19.3	12.8	6.5	Silt loam	CL-ML
	32 B	40.0 - 41.5	98.2	95.7	91.9	75.7	68.6	63.0	21.0	13.0	19.4	13.5	5.8	Silt loam	CL-ML
Unit B	5 B	48.0 - 50.0	100.0	100.0	100.0	25.9	11.4	6.0	1.0	1.0	Nonplastic			Sand	SP-SM
	8 C3	71.0 - 73.0	100.0	100.0	99.4	98.2	96.3	90.0	6.5	2.5	Nonplastic			Silt	ML
	23 B	26.0 - 28.0	85.6	78.7	67.2	42.4	37.3	32.0	9.9	6.5	Nonplastic			Gv sandy loam	SM
	23 C3	48.0 - 50.0	99.9	99.9	99.9	97.2	80.2	68.5	11.0	4.0	Nonplastic			Silt loam	ML
	28 B	52.0 - 54.0	85.9	91.6	71.1	22.1	18.3	13.9	5.8	3.5	Nonplastic			Loamy sand	SM
Upper Unit C	5 C1	75.0 - 77.0	100.0	99.9	90.9	12.4	10.0	8.4	3.3	1.9	Nonplastic			Sand	SP-SM
	5 C1	65.0 - 67.0	100.0	99.9	99.9	20.7	11.5	7.5	2.5	1.8	Nonplastic			Sand	SW-SM
	28 C3	95.0 - 97.0	99.8	98.7	96.7	21.6	16.6	11.5	4.0	3.0	Nonplastic			Sand	SM
	28 C3	110.0 - 112.0	98.0	95.3	89.6	31.5	18.1	12.5	2.5	1.5	Nonplastic			Loamy sand	SM
Subunit C2	4 C3	115.0 - 117.0	63.0	47.1	24.9	14.0	12.0	10.0	3.5	2.5	Nonplastic			V gv loamy sand	SW-SM
	5 C3	83.0 - 85.0	94.2	79.0	40.8	13.0	10.0	8.0	2.4	1.6	Nonplastic			Gv sand	SW-SM
	23 C3	115.0 - 117.0	99.1	97.8	42.2	11.4	9.8	8.0	2.9	2.0	Nonplastic			Sand	SW-SM
	25 C2	115.0 - 117.0	80.3	57.0	22.8	8.0	6.0	4.5	3.0	1.9	Nonplastic			Gv sand	SW-SM
	28 C3	120.0 - 122.0	78.9	60.8	28.9	14.5	12.1	10.0	2.9	2.0	Nonplastic			Gv loamy sand	SM
	31 C2	115.0 - 116.5	70.8	48.4	29.1	19.2	17.8	12.0	2.5	2.0	Nonplastic			V gv loamy sand	SM

TABLE 2-2

SOIL CHARACTERIZATION DATA FROM 1988 AND 1989 INVESTIGATIONS[1]
FOUR COUNTY LANDFILL
FULTON COUNTY, INDIANA

Stratigraphic Unit Sampled[2]	Boring Identification	Sample Depth (feet bgs)	Texture (Percent Finer)								Atterberg Limits			Soil Classification	
			Sieve					Hydrometer							
			#4, 4.75 (mm)	#10, 2.00 (mm)	#35, 0.50 (mm)	#120, 0.125 (mm)	#200, 0.074 (mm)	0.050 (mm)	0.005 (mm)	0.002 (mm)	LL (percent)	PL (percent)	PI	USDA	Unified[3]
Unit C Muddy Zone	5 C3	113.0 - 115.0	100.0	100.0	99.7	98.0	87.5	74.0	17.3	10.9	25.3	15.0	10.3	Silt loam	CL
Unit C Diamict Zone	30 C3	110.0 - 111.5	100.0	99.8	98.9	93.1	89.3	84.5	43.0	26.5	31.2	15.8	15.4	Silt loam	CL
Lower Unit C	8 C3	131.0 - 133.0	82.2	67.6	42.4	13.4	10.5	8.9	2.8	1.9	Nonplastic			Gv sand	SW-SM
	23 C3	135.0 - 137.0	96.7	85.2	69.7	11.3	8.9	7.5	2.0	2.0	Nonplastic			Sand	SP-SM
	28 C3	130.0 - 132.0	100.0	99.6	86.1	15.1	11.5	9.0	2.5	1.8	Nonplastic			Sand	SP-SM

Notes:

[1] Modified from Table 1 of the April 28, 1989 Memorandum Report by Geosciences Research Associates, Inc. regarding the 1988 and 1989 investigations.

[2] Stratigraphic units are defined as follows:
- A = Glacial till sequence, silty clay loam with silt and sand seams;
- B = Glacio-lacustrine sequence, silt and fine- to medium-grained sand;
- C = Glacio-fluvial sequence, poorly sorted silt, sand, and gravel; and
- D = Basal till, silty clay with reddish hue at base.

[3] Unified Soil Classification designations are as follows:
- CL = Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays;
- ML = Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity;
- SM = Silty sands, sand-silt mixtures;
- SP = Poorly graded sands, gravelly sands with little or no fines; and
- SW = Well graded, gravelly sands with little or no fines.

Key:

- bgs = Below ground surface.
- Gv = Gravelly.
- LL = Liquid limit.
- PI = Plasticity index.
- PL = Plastic limit.
- USDA = U.S. Department of Agriculture.
- V = Very.

TABLE 2-3

CATION EXCHANGE CAPACITY AND CALCIUM CARBONATE EQUIVALENCY DATA[1] FOUR COUNTY LANDFILL SITE FULTON COUNTY, INDIANA

Stratigraphic Unit Sampled[2]	Boring Identification	Sample Depth (feet bgs)	CEC (meq/100 g)	CCE (percent $CaCO_3$ equivalents)
Subunit A1	24 B	10.0 - 12.0	4.6	26.8
	28 B	22.0 - 25.5	3.6	24.3
	32 B	12.0 - 14.0	5.2	27.2
Subunit A2	24 B	17.2 - 20.0	2.3	24.6
	25 A	10.0 - 12.0	5.7	24.3
	28 B	28.0 - 30.0	5.3	24.5
	32 B	20.0 - 22.0	3.8	23.8
Subunit A22	24 B	22.0 - 24.0	2.3	18.8
	25 A	22.0 - 24.0	2.7	20.6
	28 B	36.0 - 38.0	2.6	21.8
	32 B	30.0 - 32.0	3.9	21.9
Subunit A3	24 B	46.0 - 48.0	4.3	28.8
	25 A	34.0 - 36.0	5.9	23.9
	28 B	46.0 - 48.0	3.2	24.4
	29 B	36.0 - 37.2	--	28.8
	29 B	37.2 - 38.2	--	24.8
	32 B	40.0 - 41.5	3.0	24.1

Notes:

[1] Modified from Table 2 of the April 28, 1989 Memorandum Report by Geosciences Research Associates, Inc. regarding 1988 and 1989 investigations.

[2] A detailed description of the Unit A glacial till (including subunits) is provided in the April 28, 1989 Memorandum Report prepared by John Bassett of Geosciences Research Associates, Inc.

Key:

bgs = Below ground surface.
$CaCO_3$ = Calcium carbonate.
CCE = Calcium carbonate equivalency.
CEC = Cation exchange capacity.
meq = Milliequivalents
-- = No data reported.

TABLE 2-4

SUMMARY OF WELL LOCATIONS[1]
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA

Northwest Quadrant

Monitoring Wells = 9 Piezometers = 24

MW-1	MW-31B	P-10	P-30A	P-31A	P-34*A[2]
MW-8	MW-32B	P-11A	P-30C1	P-31C1	P-34*C1
MW-22	MW-33B	P-12A	P-30C2	P-31C2	P-34*C2
MW-26	MW-34*B[2]	P-13A	P-30C3	P-31C3	P-34*C3
MW-30B		P-14A	P-30C4	P-31C4	P-34*C4
		P-26A			
		P-33A	P-32A		
			P-32C2		

P-34A Sump
6" Diameter Supply Well

Northeast Quadrant

Monitoring Wells = 11 Piezometers = 20

MW-2	MW-28S	P-7A	P-8A	P-23A	P-28A
MW-3	MW-28B	P-7B	P-8B	P-23C1	P-28C1
MW-20	MW-28M		P-8C1	P-23C2	P-28C2
MW-23S	MW-29B	P-29A	P-8C2	P-23C3	P-28C3
MW-23M		P-29C2	P-8C3	P-23C4	P-28C4
MW-23B			P-8C4		
MW-23L					

Southwest Quadrant

Monitoring Wells = 7 Piezometers = 19

MW-6	MW-24S	P-1A	P-2	P-5A	P-24A
MW-7	MW-24M	P-1	P-2A	P-5B	P-24C1
	MW-24B	P-3	P-2B	P-5C1	P-24C2
	MW-24L	P-6A	P-2C2	P-5C2	P-24C3
	MW-24L2			P-5C3	P-24C4
				P-5C4	

Southeast Quadrant

Monitoring Wells = 10 Piezometers = 15

MW-4	MW-25	P-3A	P-4A	P-27A
MW-5	MW-25B	P-21A	P-4B	P-27C1
MW-21S	MW-27S		P-4C1	P-27C2
MW-21M	MW-27M	P-25A	P-4C2	P-27C3
MW-21L	MW-27B	P-25C2	P-4C3	P-27C4
			P-4C4	

Former Support Facilities (Trailer) Supply Well

Notes:

(1) All wells known to have been installed are listed, although some may have been damaged or abandoned.

(2) A piezometer/monitoring well cluster with a numeric designation of "34*" was installed by Geosciences Research Associates between December 1988 and January 1989. The asterisk (*) is not a footnote, but rather a means of distinguishing this cluster from P-34A, also located in the northwest quadrant.

Totals:	
Piezometers	78
Monitoring wells	37
Water supply wells	2
Sumps	1
	118

TABLE 2-5

SUMMARY OF MONITORING WELL AND PIEZOMETER DATA (1)
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA
(Page 1 of 7)

Piezometer/ Well Identification	Stratigraphic Unit(s) Screened (2)	Former/ Other Identification	Casing Elevation (feet amsl)	Site Quadrant (3)	Date of Installation	Well Depth (feet bgs)/ Bottom Elevation (feet amsl)	Screen Length (feet)	Sand Pack Length (feet)	Well Construction Details (4)	Comments
P-1	B	MW-1B	783.07	SW	12/08/86	65.0/718.1	5	13.0	hand slotted PVC, 1" dia., 3.75" dia. borehole, 5' bentonite seal	
P-1A	A	--	787.64	SW	12/05/88	37.1/749.2	2	2.7	4.25" dia. borehole, 2' bentonite seal, (5)	
P-2	B	--	777.55	SW	12/15/86	80.0/697.9	10	12.0	hand slotted PVC, 1" dia., 7.25" dia. borehole, 8' bentonite seal	
P-2A	A	--	777.38	SW	12/05/88	17.0/758.0	2	2.6	4.25" dia. borehole, 3' bentonite seal, (5)	
P-2B	B	MW-2B	777.05	SW	12/05/88	72.2/702.7	4	6.4	4.25" dia. borehole, 7.8' bentonite seal, (5)	
P-2C2	C	--	776.86	SW	02/09/89	134.9/639.8	2	5.5	4.9" dia. borehole, no bentonite seal, (5)	
P-3	B ?	--	772.71	SW	12/10/86	50.9/715.4	5	18.9	hand slotted PVC, 1" dia., 3.75" dia. borehole, 2' bentonite seal	Assume casing removed 12/19/86.
P-3A	A ?	--	766.22	SE	?	?	?	?	?	Assume casing removed during Cell B construction.
P-4A	A	--	790.03	SE	11/07/88	19.0/769.1	2	2.8	4.25" dia. borehole, 2' bentonite seal, (5)	
P-4B	B	--	790.00	SE	11/04/88	69.6/718.6	4	6.4	4.25" dia. borehole, 2.7' bentonite seal, (5)	
P-4C1	C	--	791.02	SE	01/04/89	85.6/703.9	2	4.0	4.9" dia. borehole, no bentonite seal, (5)	
P-4C2	C	--	791.72	SE	01/03/89	132.9/656.7	2	4.0	4.9" dia. borehole, no bentonite seal, (5)	
P-4C3	C	--	791.71	SE	02/02/89	155.6/633.9	2	4.5	4.9" dia. borehole, no bentonite seal, (5)	
P-4C4	C	--	791.02	SE	01/27/89	152.5/637.0	2	4.0	Schedule 80 PVC, 4.9" dia. borehole, no bentonite seal, (5)	
P-5A	A/B ?	--	776.93	SW	11/08/88	28.1/746.3	2	4 ?	4.25" dia. borehole, 2' bentonite seal, (5)	
P-5B	B	MW-5B	776.86	SW	11/03/88	49.1/725.0	5	6.1	4.25" dia. borehole, 2' bentonite seal, (5)	
P-5C1	C	--	776.63	SW	01/12/89	77.1/696.6	2	3.0	4.5" dia. borehole, no bentonite seal, (5)	
P-5C2	C	--	777.29	SW	01/18/89	107.4/666.9	2	4.0	4.9" dia. borehole, no bentonite seal, (5)	
P-5C3	C	--	777.05	SW	01/18/89	119.8/654.5	2	2.8	4.9" dia. borehole, no bentonite seal, (5)	
P-5C4	C	--	777.23	SW	01/26/89	166.2/608.3	2	5.0	Schedule 80 PVC, 4.9" dia. borehole, no bentonite seal, (5)	
P-6A	A	P-6	776.57	SW	11/01/88	21.0/752.9	2	3.0	4.25" dia. borehole, 2.1' bentonite seal, (6)	
P-7A	B ?	--	771.24	NE	11/18/88	21.4/748.0	2	2.7	4.25" dia. borehole, 2' bentonite seal, (5)	

TABLE 2-5

SUMMARY OF MONITORING WELL AND PIEZOMETER DATA (1)
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA

Piezometer/ Well Identification	Stratigraphic Unit(s) Screened (2)	Former/ Other Identification	Casing Elevation (feet amsl)	Site Quadrant (3)	Date of Installation	Well Depth (feet bgs)/ Bottom Elevation (feet amsl)	Screen Length (feet)	Sand Pack Length (feet)	Well Construction Details (4)	Comments
P-7B	B	MW-7B	770.92	NE	11/17/88	50.9/718.4	5	6.0	4.25" dia. borehole, 2' bentonite seal, (5)	
P-8A	A	--	757.70	NE	11/23/88	19.9/735.4	2	3.9	4.25" dia. borehole, 2' bentonite seal, (5)	
P-8B	B	MW-8B	756.99	NE	11/02/88	47.9/707.2	4	5.5	4.25" dia. borehole, 6' bentonite seal, (5)	
P-8C1	C	--	757.71	NE	01/25/89	79.8/675.3	2	3.8	5.25" dia. borehole, no bentonite seal, (5)	
P-8C2	C	--	757.68	NE	01/27/89	113.0/642.8	2	4.0	4" dia. borehole, no bentonite seal, (5)	
P-8C3	C	--	757.34	NE	01/26/89	133.5/622.1	2	4.5	4.75" dia. borehole, no bentonite seal, (5)	
P-8C4	C	MW-8C4	757.68	NE	01/03/89	180.5/575.3	2	5.4	Schedule 80 PVC, 5.75" dia. borehole, no bentonite seal, (5)	
P-10	A	P-10A	797.05	NW	11/18/88	14.5/779.4	2	2.8	4.25" dia. borehole, 2' bentonite seal, (5)	Drilled through refuse.
P-11A	A	--	796.20	NW	11/21/88	13.5/780.6	2	3.2	4.25" dia. borehole, 2' bentonite seal, (5)	
P-12A	A	--	796.90	NW	11/16/89	19.6/774.2	2	3.0	3.25" dia. borehole, 0.5' bentonite seal, (5)	Drilled through refuse.
P-13A	A	--	799.94	NW	11/17/89	21.6/775.2	4	6.0	3.25" dia. borehole, 1' bentonite seal, screened in refuse, (5)	Drilled through refuse.
P-14A	A	--	797.72	NW	11/20/89	21.5/773.2	4	5.5	3.25" dia. borehole, 1' bentonite seal, (5)	Drilled through refuse.
P-21A	A	MW-21A	776.50	SE	11/09/88	22.3/752.2	2	2.8	4.25" dia. borehole, 2' bentonite seal, (5)	
P-23A	A	MW-23A	760.15	NE	11/23/88	19.3/738.5	2	3.3	4.25" dia. borehole, 2' bentonite seal, (5)	
P-23C1	C	--	761.08	NE	01/13/89	77.7/680.4	2	5.9	4.75" dia. borehole, no bentonite seal, (5)	
P-23C2	C	--	761.15	NE	01/12/89	116.1/642.0	2	3.7	4.75" dia. borehole, no bentonite seal, (5)	
P-23C3	C	--	760.83	NE	01/12/89	136.5/621.1	2	3.9	4.75" dia. borehole, no bentonite seal, (5)	
P-23C4	C	--	760.03	NE	01/18/89	177.7/580.5	2	4.5	Schedule 80 PVC, 5.75" dia. borehole, no bentonite seal, (5)	Two points identified on 4/15/91 site map.
P-24A	A	MW-24A	788.29	SW	12/04/88	28.8/757.5	2	2.7	4.25" dia. borehole, 2' bentonite seal, (5)	
P-24C1	C	--	788.32	SW	01/19/89	89.9/696.2	2	4.4	4.75" dia. borehole, no bentonite seal, (5)	
P-24C2	C	--	787.90	SW	01/18/89	104.9/681.2	2	3.2	4.75" dia. borehole, no bentonite seal, (5)	

TABLE 2-5

SUMMARY OF MONITORING WELL AND PIEZOMETER DATA (1)
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA
(Page 3 of 7)

Piezometer/ Well Identification	Stratigraphic Unit(s) Screened (2)	Former/ Other Identification	Casing Elevation (feet amsl)	Site Quadrant (3)	Date of Installation	Well Depth (feet bgs)/ Bottom Elevation (feet amsl)	Screen Length (feet)	Sand Pack Length (feet)	Well Construction Details (4)	Comments
P-24C3	C	--	788.51	SW	01/17/89	119.1/666.9	2	4.5	4.75" dia. borehole, no bentonite seal, (5)	
P-24C4	C	--	788.43	SW	01/16/89	131.2/654.9	2	4.4	Schedule 80 PVC, 4.75" dia. borehole, no bentonite seal, (5)	
P-25A	A	MW-25A	793.83	SE	12/06/88	32.2/759.9	2	3.0	4.25" dia. borehole, 2.3' bentonite seal, (5)	
P-25C2	C	--	794.86	SE	01/20/89	122.0/670.4	2	4.0	4.75" dia. borehole, no bentonite seal, (5)	
P-26A	A	--	792.32	NW	11/21/89	13.9/775.3	3.5	3.7	3.25" dia. borehole, 0.5' bentonite seal, (5)	
P-27A	A	MW-27A	780.35	SE	12/01/88	17.0/761.6	2	3.5	4.25" dia. borehole, 2' bentonite seal, (5)	
P-27C1	C	--	780.42	SE	01/13/89	79.3/699.8	2	4.0	4.75" dia. borehole, no bentonite seal, (5)	
P-27C2	C	--	780.10	SE	01/10/89	109.3/669.4	2	5.0	4" dia. borehole, no bentonite seal, (5)	
P-27C3	C	--	780.10	SE	01/12/89	130.3/648.4	2	6.0	4.25" dia. borehole, no bentonite seal, (5)	
P-27C4	C	--	781.96	SE	01/17/89	180.7/599.5	2	4.5	Schedule 80 PVC, 4.75" dia. borehole, no bentonite seal, (5)	
P-28A	A	MW-28A	775.37	NE	11/28/88	26.1/748.2	2	3.0	4.25" dia. borehole, 2' bentonite seal, (5)	
P-28C1	B	--	777.05	NE	01/16/89	85.0/689.4	2	3.2	4.25" dia. borehole, no bentonite seal, (5)	
P-28C2	C	--	776.35	NE	01/26/89	121.9/652.2	2	4.5	Schedule 80 PVC, 5.75" dia. borehole, no bentonite seal, (5)	
P-28C3	C	--	776.79	NE	01/26/89	135.1/639.1	2	6.0	4.75" dia. borehole, no bentonite seal, (5)	
P-28C4	C	--	776.50	NE	01/25/89	201.8/572.3	2	7.0	Schedule 80 PVC, 5.75" dia. borehole, no bentonite seal, (5)	
P-29A	A	MW-29A	773.78	NE	11/30/88	13.5/758.1	2	2.4	4.25" dia. borehole, 4' bentonite seal, (5)	
P-29C2	C	--	772.92	NE	01/18/89	116.2/655.4	2	4.9	4" dia. borehole, no bentonite seal, (5)	
P-30A	A	MW-30A	761.97	NW	11/22/88	20.4/739.6	2	2.9	4.25" dia. borehole, 2.5' bentonite seal, (5)	
P-30C1	C	--	762.56	NW	01/23/89	59.8/700.0	2	4.3	4" dia. borehole, no bentonite seal, (5)	
P-30C2	C	--	764.02	NW	01/31/89	102.4/659.2	2	4.5	4.75" dia. borehole, no bentonite seal, (5)	
P-30C3	C	--	764.37	NW	01/30/89	122.4/639.1	2	4.2	4.75" dia. borehole, no bentonite seal, (5)	

TABLE 2-5

SUMMARY OF MONITORING WELL AND PIEZOMETER DATA (1)
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA

Piezometer/ Well Identification	Stratigraphic Unit(s) Screened (2)	Former/ Other Identification	Casing Elevation (feet amsl)	Site Quadrant (3)	Date of Installation	Well Depth (feet bgs)/ Bottom Elevation (feet amsl)	Screen Length (feet)	Sand Pack Length (feet)	Well Construction Details (4)	Comments
P-30C4	C	--	762.87	NW	01/19/89	219.8/541.0	2	10.3	Schedule 80 PVC, 4.75" dia. borehole, no bentonite seal, (5)	
P-31A	A	MW-31A	783.02	NW	11/29/88	14.9/765.7	2	2.9	4.25" dia. borehole, 2' bentonite seal, (5)	
P-31C1	C	--	782.78	NW	01/10/89	86.7/694.0	2	2.6	4.75" dia. borehole, no bentonite seal, (5)	
P-31C2	C	--	782.60	NW	01/09/89	111.6/669.1	2	2.5	4.75" dia. borehole, no bentonite seal, (5)	
P-31C3	C	--	782.75	NW	01/06/89	134.2/646.5	2	3.5	4" dia. borehole, no bentonite seal, (5)	
P-31C4	C	--	782.77	NW	01/17/89	194.1/586.5	2	3.4	Schedule 80 PVC, 4.75" dia. borehole, no bentonite seal, (5)	
P-32A	A	--	798.53	NW	11/22/89	18.1/777.7	4.5	5.0	3.25" dia. borehole, 0.3' bentonite seal, (5)	
P-32C2	C	--	797.84	NW	01/13/89	130.8/665.0	2	2.8	4.75" dia. borehole, no bentonite seal, (5)	
P-33A	A	MW-33A	798.06	NW	11/11/88	20.0/775.2	2	3.1	4.25" dia. borehole, 2' bentonite seal, (5)	
P-34A	A	MW-34A	794.73	NW	10/11/88	18.8/772.8	2	2.7	4.25" dia. borehole, 2' bentonite seal, (5)	Drilled through refuse. Removed 11/07/89. Now a sump.
P-34*A	A	MW-34*A	796.01	NW	12/07/88	26.0/767.9	1.3	3.0	4.25" dia. borehole, 2' bentonite seal, (5)	
P-34*C1	C	--	796.16	NW	01/10/89	97.7/696.4	2	2.7	4.25" dia. borehole, no bentonite seal, (5)	
P-34*C2	C	--	795.88	NW	01/12/89	126.6/667.3	2	4.0	4.75" dia. borehole, no bentonite seal, (5)	
P-34*C3	C	--	796.27	NW	01/11/89	149.8/644.1	2	3.8	4.75" dia. borehole, no bentonite seal, (5)	
P-34*C4	C	--	796.29	NW	01/11/89	193.7/600.3	2	3.7	Schedule 80 PVC, 4.75" dia. borehole, no bentonite seal, (5)	
MW-1	A/B ?	W-1	790.61	NW	12/26/78	42/749	2	?	4" dia. casing, glued joints, 25-slot screen, no bentonite seal or grout.	Buried ?
MW-2	A	W-2	769.88	NE	12/26/78	20/750	2	?	4" dia. casing, glued joints, 25-slot screen, no bentonite seal or grout.	Not accessible ?
MW-3	A ?	W-3	771.57	NE	12/27/78	38/732	2	?	4" dia. casing, glued joints, 25-slot screen, no bentonite seal or grout.	
MW-4	A	W-4	786.24	SE	02/20/79	19/?	7 ?	?	4" dia. casing, glued joints, 25-slot screen, no bentonite seal or grout.	Disturbed, casing broken
MW-5	B	W-5	789.23	SE	02/20/79	35/740	2	?	4" dia. casing, glued joints, 25-slot screen, no bentonite seal or grout.	

TABLE 2-5

SUMMARY OF MONITORING WELL AND PIEZOMETER DATA (1)
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA

Piezometer/ Well Identification	Stratigraphic Unit(s) Screened (2)	Former/ Other Identification	Casing Elevation (feet amsl)	Site Quadrant (3)	Date of Installation	Well Depth (feet bgs)/ Bottom Elevation (feet amsl)	Screen Length (feet)	Sand Pack Length (feet)	Well Construction Details (4)	Comments
MW-6	A/B ?	W-6	780.63	SW	01/03/79	51/724	2	?	4" dia. casing, glued joints, 25-slot screen, no bentonite seal or grout	Formerly buried. Casing raised ~3.5'
MW-7	B ?	W-7	776.87	SW	12/29/78	36/737	2	?	4" dia. casing, glued joints, 25-slot screen, no bentonite seal or grout	Not accessible. Buried ?
MW-8	B/C ?	W-8	?	NW	?	?	?	?	?	Former residential well. Buried ?
MW-20	A/B ?	W-20	767.23	NE	05/19/83	45.5/721.7	15	17.5 ?	4" dia. PVC, 10.5" dia. borehole, 2' bentonite seal	Possible grout contamination.
MW-21S	B	W-21, MW-21	778.00	SE	05/27/83	60.0/718.0	15	20.0	4" dia. PVC, 10.5" dia. borehole, 2' bentonite seal	
MW-21M	C	--	777.37	SE	01/27/87	94.8/682.5	10	18.3	4.5" dia. borehole, 11.5' bentonite seal	
MW-21L	C	--	777.01	SE	01/20/87	212.0/565.0	10	14.0	4.5" dia. borehole, 5' bentonite seal	
MW-22	B	--	757.17	NW	06/01/83	38.5/718.7	15	14.5	4" dia. PVC, 10.5" dia. borehole, 2' bentonite seal	
MW-23B	B	MW-23BW	759.84	NE	11/22/88	39.4/718.2	5	7.0	4.5" dia. borehole, 2' bentonite seal	
MW-23S	A/B	--	765.41	NE	04/08/85	48.0/717.4	20	24.0	6.5" dia. borehole	
MW-23M	A/B/C	--	765.46	NE	04/08/85	85.5/680.0	20	69.5	6.5" dia. borehole, 1' bentonite seal	
MW-23L	B/C	MW-23D	765.50	NE	04/08/85	122.0/643.5	20	92.0	6.5" dia. borehole, 1' bentonite seal	
MW-24B	B	P-24B	787.70	SW	12/04/88	74.2/711.9	5	7.0	4.5" dia. borehole, 2' bentonite seal, (5)	
MW-24S	B	P-24S	789.66	SW	12/05/86	75.0/714.7	10	19.0	7.25" dia. borehole, 5' bentonite seal	
MW-24M	B/C	P-24M	788.96	SW	01/26/87	108.5/680.5	10	28.5	4.5" dia. borehole, 5' bentonite seal	
MW-24L	C/D	MW-24L1, P-24L	788.86	SW	01/22/87	142.8/646.0	10	22.8	4.5" dia. borehole, 5' bentonite seal	Abandoned, not plugged. High pH grout? Replaced.
MW-24L2	C	MW-24La, P-24L2	788.65	SW	4/87, 5/87	136.0/652.6	10	36.0	Schedule 80 PVC, 4.5" dia. borehole, 56' bentonite seal	
MW-25	A/B	OW-25	789.96	SE	12/17/86	74.0/716.0	10	38.0	7.25" dia. borehole, 5' bentonite seal	Possible grout contamination.

TABLE 2-5

SUMMARY OF MONITORING WELL AND PIEZOMETER DATA (1)
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA

Piezometer/ Well Identification	Stratigraphic Unit(s) Screened (2)	Former/ Other Identification	Casing Elevation (feet amsl)	Site Quadrant (3)	Date of Installation	Well Depth (feet bgs)/ Bottom Elevation (feet amsl)	Screen Length (feet)	Sand Pack Length (feet)	Well Construction Details (4)	Comments
MW-25B	B/C ?	MW-25BW, P-25B	793.81	SE	12/07/88	78.5/713.7	5	6.5	4.5" dia. borehole, 2' bentonite seal, (5)	
MW-26	B	OW-26	791.40	NW	01/06/87	77.2/714.2	10	16.7	4.5" dia. borehole, 5.5' bentonite seal	
MW-27B	B	MW-27BW	779.76	SE	12/01/88	55.0/723.2	5	7.0	4.25" dia. borehole, 2.5' bentonite seal, (5)	
MW-27S	B/C	--	778.95	SE	04/29/87	72.0/707.0	10	34.0	4.5" dia. borehole, 9.3' bentonite seal	
MW-27M	B/C	--	779.44	SE	04/29/87	101.4/678.0	10	48.4	4.5" dia. borehole, 10' bentonite seal	
MW-28B	B	MW-28BW	775.64	NE	11/28/88	60.0/713.7	5	6.8	4.25" dia. borehole, 2' bentonite seal, (5)	
MW-28S	A/B	--	775.71	NE	05/04/87	60.5/715.2	10	17.5	4.5" dia. borehole, 10' bentonite seal, (5)	
MW-28M	B/C	--	776.20	NE	05/01/87	101.0/675.2	10	28.0	4.5" dia. borehole, 5' bentonite seal, (5)	
MW-29B	B	MW-29BW	773.43	NE	11/30/88	51.9/719.3	5	7.4	4.25" dia. borehole, 9.8' bentonite seal, (5)	
MW-30B	B	MW-30BW	762.02	NW	11/21/88	42.2/718.8	5	8.2	4.25" dia. borehole, 4' bentonite seal, (5)	
MW-31B	B	MW-31BW	782.99	NW	11/29/88	61.9/719.0	5	6.9	4.5" dia. borehole, 3' bentonite seal, (5)	
MW-32B	B	P-32B, MW-32BW	798.89	NW	11/14/88	78.0/718.4	5	8.0	4.5" dia. borehole, 2' bentonite seal, (5)	
MW-33B	B	MW-33BW	796.57	NW	11/10/88	72.5/722.2	5	8.5	4.25" dia. borehole, 12' bentonite seal, (5)	
MW-34*B	B	MW-34B	796.15	NW	12/06/88	74.9/719.2	4.2	6.2	4.25" dia. borehole, 2' bentonite seal, (5)	
6" Diameter Supply Well	B/C ?	--	796.78	NW	?	?	?	?	?	
Former Support Facilities (Trailer) Well	?	--	?	SE	?	?	?	?	?	

TABLE 2-5

SUMMARY OF MONITORING WELL AND PIEZOMETER DATA (1)
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA
(Page 7 of 7)

Notes:

(1) This monitoring well and piezometer summary was derived from data tables and well constructions logs included in the following sources:
- o Site Map (4/15/91) obtained from Geosciences Research Associates, Inc.;
- o "CAP Task I - Description of Current Conditions," Geosciences Research Associates, Inc. (12/7/89);
- o Memorandum Report, Geosciences Research Associates, Inc. (4/28/89); and
- o "Hazardous Waste Ground-Water Task Force Evaluation of the Four County Landfill, Fulton County, IN," USEPA, May 1987.

(2) Stratigraphic units are defined as follows:
- A = Glacial till sequence, silty clay loam with silt and sand seams;
- B = Glacio-lacustrine sequence, silt and fine- to medium-grained sand;
- C = Glacio-fluvial sequence, poorly sorted silt, sand, and gravel; and
- D = Basal till, silty clay with reddish hue at base.

(3) Site quadrants are arbitrarily defined by the 7+00 North and 8+00 East survey grid lines.

(4) Well materials are assumed to be 2-inch-diameter, threaded, Schedule 40 PVC with a 10-slot screen, unless otherwise noted.

(5) Well annulus filled with Volclay grout from filter pack or annular seal to surface.

(6) Well annulus filled with pea gravel and bentonite grout from filter pack or annular seal to surface.

Key:

amsl = Above mean sea level.
bgs = Below ground surface.
dia. = Diameter.
? = Information incomplete or unavailable.
-- = Not applicable.

TABLE 2-6

AQUIFER HYDRAULIC CONDUCTIVITY RESULTS[1]
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA

Well Identification	Well Screen Interval (feet bgs)	Slug Test Analytical Method		Laboratory Analysis[2] (cm/sec)
		Hvorslev (cm/sec)	Papadopulos (cm/sec)	
MW-21S	45 - 60	1.42×10^{-5}	1.20×10^{-4}	3.5×10^{-5}
MW-21M	85 - 95	1.00×10^{-4}	2.40×10^{-4}	4.3×10^{-3}
MW-21L	202 - 212	6.00×10^{-6}	1.54×10^{-5}	2.6×10^{-5}
MW-25	64 - 74	1.37×10^{-4}	(3)	--
MW-26	67 - 77	1.06×10^{-5}	4.20×10^{-5}	--

Notes:

(1) Modified from Table 7 of Dames and Moore's "Hydrogeologic Assessment Report" dated January 12, 1988.

(2) Falling head permeability tests were performed on reconstituted or remolded samples.

(3) No type curve match was possible.

Key:

bgs = Below ground surface.

-- = No data reported.

TABLE 3-1

WASTE CLASSIFICATION[1]
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA

General Waste Type	Years Deposited	Volume (cubic yards)
General Refuse	1972 through 1985	65,000.00
Special Waste (Separate Area Waste)	1978	2,764.22
	1978	25,849.36
	1980	22,872.51
		Subtotal 51,486.09
RCRA Hazardous Waste	1980	1,631.80
	1981	22,862.23
	1982	11,898.70
	1983	15,592.94
	1984	11,693.84
	1985	31,725.09
	1986	16,066.39
	1987	72,739.96
	1988	156,656.57
	1989 (January - March)	44,381.52
		Subtotal 385,249.04
		Total 501,735.13

Note:

(1) Modified from Table C-2 of RSC's April 13, 1989 "Closure and Post-Closure Plans." Not intended to be a complete or detailed listing.

TABLE 3-2

WASTE TYPES AND DESCRIPTIONS[1]
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA

Waste Type	Waste Description (Appendix VII Constituents)
D004	Arsenic
D005	Barium
D006	Cadmium
D007	Chromium
D008	Lead
D009	Mercury
D010	Selenium
F006	Wastewater treatment sludge from electroplating (Cd, Cr^{6+}, Ni, CN^-)
K002	Wastewater treatment sludge from the production of chrome yellow and orange pigments (Cr^{6+}, Pb)
K003	Wastewater treatment sludge from the production of molybdate orange pigments (Cr^{6+}, Pb)
K004	Wastewater treatment sludge from the production of zinc yellow pigments (Cr^{6+})
K005	Wastewater treatment sludge from the production of chrome green pigments (Cr^{6+}, Pb)
K006	Wastewater treatment sludge from the production of chrome oxide green pigments (Cr^{6+})
K008	Oven residue from production of chrome oxide green pigments (Cr^{6+})
K046	Wastewater treatment sludge from the manufacture, formulation, and loading of lead-based initiating compounds (Pb)
K048	Dissolved air floatation (DAF) debris from the petroleum refining industry (Cr^{6+}, Pb)
K049	Slop oil emulsion solids from the petroleum refining industry (Cr^{6+}, Pb)
K050	Heat exchanger bundle cleaning sludge from the petroleum refining industry (Cr^{6+})
K051	API separator sludge from the petroleum refining industry (Cr^{6+}, Pb)
K052	Tank bottoms (leaded) from the petroleum refining industry (Pb)
K061	Emission control dust/sludge from the primary production of steel in electric furnaces (Cr^{6+}, Pb, Cd)
K069	Emission control dust/sludge from secondary lead smelting (Cr^{6+}, Pb, Cd)
D002	Corrosive [high pH only ($\geq$ 12.5)]

Note:

[1] Modified from the text of Jacobs Engineering Inc.'s January 27, 1988 "Comprehensive Monitoring Evaluation." Original source was a February 26, 1987 RCRA Part A Permit Application submitted by Environmental Waste Control, Inc. Not intended to be a complete or detailed listing.

TABLE 6-1

POTENTIAL FEDERAL AND STATE LOCATION-SPECIFIC ARARs[1]
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA

Location	Requirement	Citation
Within 100-year floodplain	Facility must be designed, constructed, operated, and maintained to avoid washout.	40 CFR 264.18(b); 329 IAC 3.1[2]
Within floodplain	Action must avoid adverse effects, minimize potential harm, and if necessary, restore and preserve natural and beneficial values of the floodplain.	Executive Order 11988, Floodplain Management, (40 CFR 6, Appendix A)
Within floodplain in Indiana	Action must avoid adverse effects, minimize potential harm, and restore and preserve natural and beneficial values of the floodplain. Construction of abodes or residences is prohibited and prior approval of the IDNR is required for other types of construction, excavation, or filling in or on a floodway. This includes but is not limited to construction of a fence, water treatment facility, dredging, and/or dewatering in a floodway.	Indiana Flood Control Act (13-2-22)
Wetland	Action must minimize the destruction, loss, or degradation of wetlands. Discharge of dredged or fill material into wetlands without permit is prohibited.	Executive Order 11990, Protection of Wetlands, (40 CFR 6, Appendix A) Clean Water Act, Section 404; 40 CFR Parts 230, 231
Critical habitat upon which endangered species or threatened species depends	Action to conserve endangered species or threatened species, including consultation with the Department of Interior	Endangered Species Act of 1973 (16 USC 1531 et seq.); 50 CFR Part 200, 50 CFR Part 402 Fish and Wildlife Coordination Act (16 USC 661 et seq.); 33 CFR Parts 320-330.

Notes:

[1] Modified from Exhibit 1-2 of USEPA's Draft Guidance CERCLA Compliance With Other Laws (August 1988).

[2] As of February 1992, Indiana adopted new hazardous waste rules titled 329 IAC 3.1, which adopt by reference the Code of Federal Regulations (40 CFR 260 through 270). The State rules generally only cover the administrative procedures while the federal rules cover the standards for RCRA generators and treatment, storage, and disposal facilities.

TABLE 6-2

POTENTIAL FEDERAL AND STATE ACTION-SPECIFIC ARARs[1]
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA

Actions	Requirement	Citation
Air stripping	Design system to provide odor-free operation.	CAA Section 101[2]
	File an Air Pollution Emission Notice (APEN) with the State of Indiana to include estimation of emission rates for each pollutant expected.	40 CFR 52[2]; 326 IAC 2-1-2
	Verify through emission estimates and dispersion modeling that hydrogen sulfide emissions do not create an ambient concentration greater than or equal to 0.10 ppm.	40 CFR 61; 326 IAC 14
	Follow RCRA generator standards for manifesting, handling, record keeping, and accumulation times for waste water, if determined to be hazardous.	40 CFR 262.10-262.44; 329 IAC 3.1-7[3]
	Treatment of waste water contained in tanks over 90 days would require facility to meet TSD standards.	See Treatment (in a unit), and Tank Storage (on site) in this table.
Capping	Placement of a cap over a landfill requires a cover designed and constructed to: o Provide long-term minimization of infiltration of liquids through the capped area. o Function with minimum maintenance. o Promote drainage and minimize erosion or abrasion of the cover. o Accommodate settling and subsidence so that the cover's integrity is maintained. o Have a permeability less than or equal to the permeability of any bottom liner system or natural subsoils present.	40 CFR 264.310(a); 329 IAC 3.1[3]
	Restrict post-closure use of property as necessary to prevent damage to the cover.	40 CFR 264.117(c); 329 IAC 3.1[3]
	Prevent run-on and run-off from damaging cover.	40 CFR 264.310(b); 329 IAC 3.1[3]
	Protect and maintain surveyed benchmarks used to locate waste cells.	40 CFR 264.310(b); 329 IAC 3.1[3]
	Disposal or decontamination of equipment, structures, and soils.	40 CFR 264.114; 329 IAC 3.1[3]
Closure with waste in place (capping)	Installation of final cover to provide long-term minimization of infiltration.	40 CFR 264.310; 329 IAC 3.1[3]
	Stabilize wastes, if necessary, to support cover.	40 CFR 264.228; 40 CFR 264.258
	Post-closure care and ground water monitoring	40 CFR 264.310; 329 IAC 3.1[3]

TABLE 6-2

POTENTIAL FEDERAL AND STATE ACTION-SPECIFIC ARARs[1]
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA

Actions	Requirement	Citation
Direct discharge of treatment system effluent	Applicable federal water quality criteria for the protection of aquatic life must be complied with when environmental factors are being considered.	50 CFR 30784
	Applicable federally approved state water quality standards must be complied with. These standards may be in addition to or more stringent than other federal standards under the CWA.	40 CFR 122.44 and state regulations approved under 40 CFR 131; 327 IAC 5-2-10; 327 IAC 2
	The discharge must be consistent with the requirement of a Water Quality Management Plan approved by EPA under Section 208(b) of the Clean Water Act.	CWA Section 208(b); 327 IAC 5-2-10(e)(4)
	Use of best available technology (BAT) economically achievable is required to control toxic and nonconventional pollutants. Use of best conventional pollutant control technology (BCT) is required to control conventional pollutants. Technology-based limitations may be determined on a case-by-case basis. In some cases, the permit limit for a conventional pollutant may be more stringent than BCT.	40 CFR 122.44(a) 327 IAC 5-5-2
	Discharge limitations must be established for all toxic pollutants that are or may be discharged at levels greater than those that can be achieved by technology-based standards.	40 CFR 122.44(e)
	Discharge must be monitored to assure compliance. Discharger will monitor: o The mass of each pollutant discharged. o The volume of effluent discharged. o Frequency of discharge and other measurements as appropriate. The following records must be maintained: o Date, place, and time of measurements; o Person(s) who performed sampling or measurement; o Date(s) analyses were performed;	40 CFR 122.44(i); 327 IAC 5-2-13

TABLE 6-2

POTENTIAL FEDERAL AND STATE ACTION-SPECIFIC ARARs[1]
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA

Actions	Requirement	Citation
Direct discharge of treatment system effluent (continued)	o Person(s) who performed analyses; o Analytical techniques or methods used; and o Results for measurements and analyses.	327 IAC 5-2-14; 40 CFR 122.44(i); 327 IAC 5-2-15
	The discharge monitoring reports (DMRs) must be submitted to IDEM as required by the permit (at least annually).	
	Approved test methods for waste constituents to be monitored must be followed. Detailed requirements for analytical procedures and quality controls are provided.	40 CFR 122.44(i); 40 CFR 136; 327 IAC 5-2-13(c)
	Permit application information must be submitted, including a description of activities, listing of environmental permits, etc.	40 CFR 122.21
	Comply with additional permit conditions such as: o Duty to mitigate any adverse effects of any discharge. o Report to IDEM violations of maximum daily discharge for certain pollutants within 24 hours. o Proper operation and maintenance of treatment systems.	40 CFR 122.41(i); 327 IAC 5-2-8
	Develop and implement a Best Management Practices (BMP) program and incorporate in the NPDES permit to prevent the release of toxic constituents to surface waters.	40 CFR 125.100; 327 IAC 5-9
	The BMP program must: o Establish specific procedures for the control of toxic and hazardous pollutant spills. o Include a predication of direction, rate of flow, and total quantity of toxic pollutants where experience indicates a reasonable potential for equipment failure	40 CFR 125.104
	Prescribed sample preservation procedures, container materials, and maximum allowable holding times.	40 CFR 136.1-136.4; 327 IAC 5-2-13(c)

TABLE 6-2

POTENTIAL FEDERAL AND STATE ACTION-SPECIFIC ARARs[1]
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA

Actions	Requirement	Citation
Discharge to POTW	Pollutants that pass through the POTW without treatment, interfere with POTW operation, or contaminate POTW sludge are prohibited.	40 CFR 403.5; 327 IAC 5-11-1
	Specific prohibitions preclude the discharge of pollutants to POTWs that:	40 CFR 403.5;
	o Create a fire or explosion hazard in the POTW.	327 IAC 5-12-2(b)
	o Are corrosive (pH < 5.0)	
	o Obstruct flow resulting in interference.	
	o Are discharged at a flow rate and/or concentration that will result in interference.	
	o Increase the temperature of wastewater entering the treatment plant that would result in interference, or raise the POTW influent temperature above 104°F (40°C).	
	Discharge must comply with local POTW pretreatment program, including POTW-specific pollutants, spill prevention program requirements, and reporting and monitoring requirements.	40 CFR 403.5 and local POTW regulations
	RCRA permit-by-rule requirements may be applicable to discharges of RCRA hazardous wastes to POTWs by truck, rail, or dedicated pipe.	40 CFR 264.71; 40 CFR 264.72; 40 CFR 262; 40 CFR 270.60(C); 40 CFR 264.1; 40 CFR 261.3(A)(2)(IV); CWA Section 402 or 307(b); 329 IAC 3.1-7[3]
Gas collection	Meet Clean Air Act requirements, and meet state ambient air quality standards.	CAA; 326 IAC 1-3
	Design system to provide odor-free operation.	CAA Section 101[2]; 40 CFR 52[2]
	Establish procedures for review for construction and operation of any source that has the potential to emit criteria air pollutants. File an Air Pollution Emission Notice (APEN) with state to include estimation of emission rates for each pollutant expected.	40 CFR 52[2]; 326 IAC 2
	Verify through emission estimates and dispersion modeling that hydrogen sulfide emissions do not create an ambient concentration greater than or equal to 0.10 ppm.	40 CFR 61[2]; 326 IAC 14
	Meet established limits for VOC emissions. Best Available Control Technology (BACT) is required if emissions exceed 25 tons/year.	326 IAC 8-1

TABLE 6-2

POTENTIAL FEDERAL AND STATE ACTION-SPECIFIC ARARs[1]
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA

Actions	Requirement	Citation
Operation and maintenance (O&M)	Post-closure care to ensure that site is maintained and monitored.	40 CFR 264.118 (RCRA Subpart G); 329 IAC 3.1[3]
	Develop Contingency Plan and Emergency Procedures to minimize potential hazards from fires, explosions or any unplanned release during closure and post-closure status.	40 CFR 264 (Subpart D)
Security	Sites should be secured in accordance with this rule which: 1) Requires prevention of unknowing and unauthorized entry of persons or livestock if physical contact with the waste, etc. could cause injury or, if disturbance of the waste, etc. would cause a violation. 2) The facility must have either: A 24 hour surveillance system which continuously monitors and controls entry or an artificial or natural barrier which completely surrounds the active portion and a means to control entry (i.e., a lock) at all times, through the gates or other entrances to the active portion. 3) "Danger - Unauthorized Personnel Keep Out" signs are required at each entrance and other locations sufficient to be seen from any approach, legible from a distance of at least 25 feet.	40 CFR 264 (Subpart C)
Slurry wall	Excavation of soil for construction of slurry wall may trigger cleanup or land disposal restrictions.	See Consolidation, Excavation in this table.
Surface water control	Prevent run-on, and control and collect runoff from a 24-hour, 25-year storm during closure and post-closure status.	40 CFR 264.301(f)(g)(h); 329 IAC 3.1[3]
Tank storage (on-site)[4]	Ensure tanks have sufficient structural strength that they do not collapse, rupture, or fail.	40 CFR 264.190
	Ensure waste is not incompatible with the tank material unless the tank is protected by a liner or by other means.	40 CFR 264.191
	Provide tanks with secondary containment and controls to prevent overfilling, and maintain sufficient freeboard in open tanks to prevent overtopping by wave action or precipitation.	40 CFR 264.193-194
	Inspect the following: overfilling control, control equipment, monitoring data, waste level (for uncovered tanks), tank condition, above-ground portions of tanks (to assess their structural integrity), and the area surrounding the tank (to identify signs of leakage).	40 CFR 264.195
	Repair any corrosion, crack, or leak.	40 CFR 264.196

TABLE 6-2

POTENTIAL FEDERAL AND STATE ACTION-SPECIFIC ARARs[1]
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA

Actions	Requirement	Citation
Tank storage (on-site)[4] (continued)	At closure, remove all hazardous waste and hazardous waste residues from tanks, discharge control equipment, and discharge confinement structures.	40 CFR 264.197
	Storage of banned wastes must be in accordance with 40 CFR 268. When such storage occurs beyond one year, the owner/operator bears the burden of proving that such storage is solely for the purpose of accumulating sufficient quantities to allow for proper recovery, treatment and disposal.	40 CFR 268.50
Treatment	Standards for miscellaneous units (long-term retrievable storage, thermal treatment other than incineration, open burning, open detonation, chemical, physical, and biological treatment units other than tanks, surface impoundments, or land treatment units) require new miscellaneous units to satisfy environmental performance standards by protection of ground water, surface water, and air quality, and by limiting surface and subsurface migration.	40 CFR 264 (Subpart X); 329 IAC 3.1[3]
	Requires permit for construction of treatment facility and specifies standards for facility.	327 IAC 3
	Treatment of wastes subject to ban on land disposal must attain levels achievable by best demonstrated available treatment technologies (BDAT) for each hazardous constituent in each listed waste.	40 CFR 268 (Subpart D)
	Prepare fugitive and odor emission control plan for this action.	CAA Section 101[2]; 40 CFR 52[2]
	Establish procedures for review of construction and operation of any source that has the potential to emit criteria air pollutants. File an Air Pollution Emission Notice (APEN) with state to include estimation of emission rates for each pollutant expected.	40 CFR 52[2]; 326 IAC 2
	Verify through emission estimates and dispersion modeling that hydrogen sulfide emissions do not create an ambient concentration greater than or equal to 0.10 ppm.	40 CFR 61[2]; 326 IAC 14
Treatment (in a unit)	Meet requirements for design and operating standards for a specified unit in which hazardous waste is treated (see citation).	40 CFR 264.190-264.192 (Tanks) 40 CFR 264.601 (Miscellaneous Treatment Unit)

TABLE 6-2

POTENTIAL FEDERAL AND STATE ACTION-SPECIFIC ARARs[1]
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA

Actions	Requirement	Citation
Excavation	Area from which materials are excavated may require cleanup to levels established by closure requirements.	40 CFR 264 Disposal and Closure Requirements; 329 IAC 3.1[3]
	Movement of wastes beyond the site boundary (i.e., outside the landfilled area) may trigger Land Ban requirements and restrictions.	40 CFR 268
	Removal of non-hazardous excavated material from a CERCLA site may qualify the material as special waste and is subject to state regulations for special waste.	329 IAC 2-21
	All listed and characteristic hazardous wastes or soils and debris contaminated by a RCRA hazardous waste and removed from a CERCLA site may not be land disposed until treated as required by Land Ban. If alternative treatment technologies can achieve treatment similar to that required by Land Ban, and if this achievement can be documented, then a variance may not be required.	40 CFR 268
	Transport and disposal of hazardous waste excavated from a CERCLA site will require state administrative and financial assurance, and state manifest.	329 IAC 3.1[3]
	Develop fugitive and odor emission control plan for this action if existing site plan is inadequate.	CAA Section 101[2]; 40 CFR 52[2]
	Particulate emissions from earth moving and material handling activities must be controlled, such that no visible emissions cross the property line and the increase in upward/downward total suspended particulate concentration is limited to 50 $\mu g/m^3$.	326 IAC 6-4
	File an Air Pollution Emission Notice (APEN) with state to include estimation of emission rates for each pollutant expected.	40 CFR 52[2]; 326 IAC 2-1-2
	Verify through emission estimates and dispersion modeling that hydrogen sulfide emissions do not create an ambient concentration greater than or equal to 0.10 ppm.	40 CFR 61[2]; 326 IAC 14
Consolidation	Consolidation in storage piles will trigger storage requirements.	40 CFR 262.34; 40 CFR 268 (Subpart E)
	Place on or in land outside unit boundary or area of contamination will trigger land disposal requirements and restrictions.	40 CFR 285 (Subpart D)
	Movement of wastes beyond the site boundary (i.e., outside the landfilled area) may trigger Land Ban requirements and restrictions.	40 CFR 268
	Develop fugitive and odor emission control plan for this action if existing site plan is inadequate.	CAA Section 101[2]; 40 CFR 52[2]

TABLE 6-2

POTENTIAL FEDERAL AND STATE ACTION-SPECIFIC ARARs[1]
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA

Actions	Requirement	Citation
Consolidation (continued)	File and Air Pollution Emission Notice (APEN) with state to include estimation of emission rates for each pollutant expected.	40 CFR 52[2]; 326 IAC 2-1-2
	Verify through emission estimates and dispersion modeling that hydrogen sulfide emissions do not create an ambient concentration greater than or equal to 0.10 ppm.	40 CFR 61[2]; 326 IAC 14

Notes:

[1] Modified from Exhibit 1-3 of USEPA's Draft Guidance CERCLA Compliance With Other Laws (August 1988) and Exhibit 1-3 of CERCLA Compliance With Other Laws, Part II (August 1989).

[2] All of the Clean Air Act ARARs that have been established by the Federal government may be covered by matching State regulations. The State may have the authority to manage these programs through the approval of its implementation plans (40 CFR 52 Subpart G)

[3] As of February 1992, Indiana adopted new hazardous waste rules titled 329 IAC 3.1, which adopt by reference the federal regulations 40 CFR 260 through 270. Therefore, any reference to these CFR citations implies coverage under the State rules. The State rules generally only cover the administrative procedures while the federal regulations cover the standards for RCRA generators and TSD facilities.

[4] Tank storage requirements are for the storage of RCRA hazardous waste. A generator who accumulates or stores hazardous waste on site for 90 days or less in compliance with 40 CFR 262.34(a)(1-4) is not subject to the full RCRA storage requirements.

Key:

CAA = Clean Air Act.
CFR = Code of Federal Regulations.
CWA = Clean Water Act.
IAC = Indiana Administrative Code.
TSD = Treatment, Storage, and Disposal.

TABLE 6-3

GROUND WATER MONITORING WELLS AND PIEZOMETERS PROPOSED FOR ABANDONMENT[1] FOUR COUNTY LANDFILL SITE FULTON COUNTY, INDIANA

Northwest Quadrant	Northeast Quadrant
MW-1 MW-8 MW-22 Total = 3	MW-2 MW-28S P-7A MW-3 MW-28M MW-23S MW-23M MW-23L Total = 8
Southwest Quadrant	**Southeast Quadrant**
MW-6 MW-24S P-2 MW-7 MW-24M P-5A MW-24L MW-24L2 Total = 8	MW-4 MW-25 P-4C4 MW-5 MW-27S MW-27M Total = 6

Note:

(1) Total number of sample points proposed for abandonment is 25.

TABLE 6-4

GROUND WATER MONITORING WELLS AND PIEZOMETERS
PROPOSED FOR SAMPLING[1]
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA

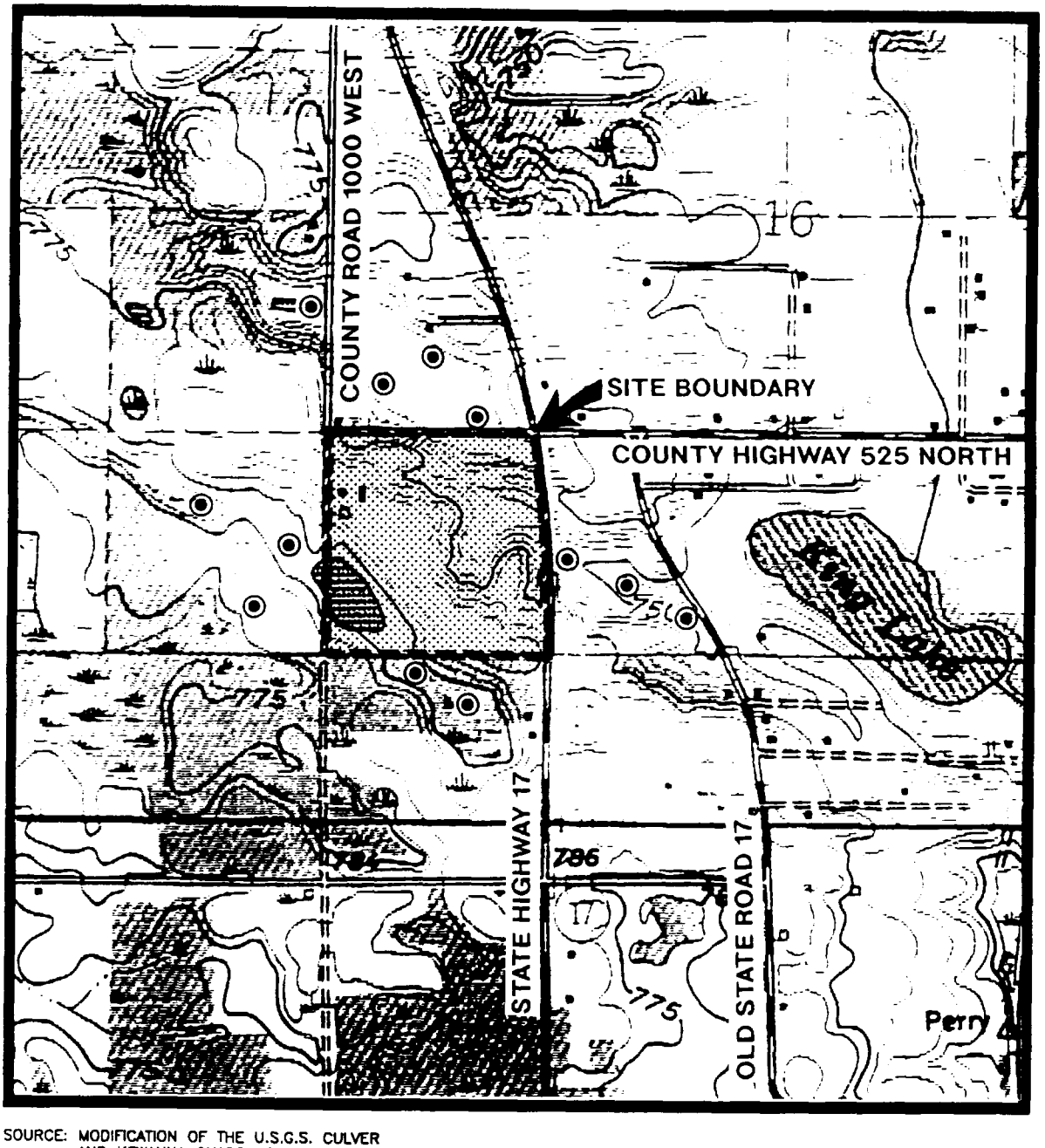
Northwest Quadrant						Northeast Quadrant				
Monitoring Wells = 6		Piezometers = 18				Monitoring Wells = 4	Piezometers = 13			
MW-26	MW-32B	P-10	P-30A	P-31A	P-34*A[2]	MW-20	P-7B	P-8A	P-23A	P-28A
MW-30B	MW-33B	P-11A	P-30C1	P-31C1	P-34*C1	MW-23B		P-8B	P-23C1	P-28C1
MW-31B	MW-34*B[2]	P-12A	P-30C2	P-31C2	P-34*C2	MW-28B	P-29A	P-8C1	P-23C2	P-28C2
		P-13A				MW-29B	P-29C2	P-8C2		
		P-14A	P-32A							
		P-26A	P-32C2							
		P-33A								
Southwest Quadrant						**Southeast Quadrant**				
Monitoring Wells = 1		Piezometers = 13				Monitoring Wells = 5	Piezometers = 11			
MW-24B		P-1A	P-2A	P-5B	P-24A	MW-21S	P-3A	P-4A	P-27A	
		P-1	P-2B	P-5C1	P-24C1	MW-21M	P-21A	P-4B	P-27C1	
			P-2C2	P-5C2	P-24C2	MW-21L	P-25A	P-4C1	P-27C2	
		P-3				MW-25B		P-4C2		
		P-6A					P-25C2			
						MW-27B				

Notes:

(1) All wells proposed for sampling are listed, although some may have been damaged or abandoned.

(2) A piezometer/monitoring well cluster with a numeric designation of "34*" was installed by Geosciences Research Associates between December 1988 and January 1989. The asterisk (*) is not a footnote, but rather a means of distinguishing this cluster from P-34A, also located in the northwest quadrant.

Totals:	
Piezometers	55
Monitoring wells	16
	71



SOURCE: MODIFICATION OF THE U.S.G.S. CULVER AND KEWANNA QUADRANGLES.

APPROX. SCALE (ft.)
0 1000

SYMBOL LEGEND:
- PROPOSED SURFACE WATER/SEDIMENT SAMPLING LOCATION

FIGURE 6-2

PROPOSED OFF-SITE SURFACE WATER AND SEDIMENT SAMPLING LOCATIONS FOUR COUNTY LANDFILL SITE FULTON COUNTY, INDIANA

PROJECT 91302-1 | REPORT TM1/SOW | BRAWN MO | CHECKED | DATE 5/27/92 | APPROVED | CLIENT NAME SONNENSCHEIN NATH & ROSENTHAL

ERM

SOMMER & BARNARD
ATTORNEYS AT LAW · PC

Lawrence A. Vanore
317/630 5935

August 12, 1992

Thomas Krueger, Esq.
Office of Regional Counsel
U.S. Environmental Protection Agency
Region V
77 West Jackson Boulevard
Chicago, IL 60604-3590

Re: Four County Landfill/Leachate Disposal

Dear Mr. Krueger:

I am writing in response to your request for a brief legal analysis of the intended disposal of leachate from the Four County Landfill at the City of Kokomo's (the "City") publicly-owned treatment works ("POTW"). In a nutshell, the City may legally accept the leachate into its sewer system, prior to reaching the POTW, under the domestic sewage exclusion of the Resource Conservation and Recovery Act ("RCRA"). 42 U.S.C. § 6903(27); 40 C.F.R. § 261.4(a)(1). In order to alleviate regulatory concerns regarding the acceptance of leachate into the sewers but outside the POTW boundary, the City will adhere to the manifest and pretreatment conditions of RCRA's permit by rule regulations. 40 C.F.R. § 270.60(c).

RCRA's permit by rule regulations provide that the owner or operator of a POTW which accepts hazardous waste for treatment shall be deemed to have a RCRA permit if certain conditions are met. Foremost among these conditions are adherence to the RCRA manifest system and the requirement that the waste meet all pretreatment requirements that would apply if the waste were discharged directly into the POTW through a sewer, pipe or similar conveyance. 40 C.F.R. § 270.60(c)(3)(ii) & (4). Adherence to the manifest and pretreatment conditions ensures that the POTW is aware of and can control the waste it is receiving. The City will adhere to the manifest and pretreatment conditions.

Once the Four County leachate is introduced to the City's sewer system, it will be excluded from RCRA regulation under the domestic sewage exclusion. The exclusion provides that "solid waste" as defined by RCRA "does not include solid or dissolved material in domestic sewage." 42 U.S.C. § 6903(27). RCRA regulations explicitly exclude from the definition of solid waste "[a]ny mixture of domestic sewage and other wastes that passes through a sewer system to a publicly-owned treatment works for

treatment." 40 C.F.R. § 261.4(a)(2)(ii). It is axiomatic that a material which is not a "solid waste" cannot be a RCRA hazardous waste. Therefore, the leachate accepted by the City's POTW cannot be a hazardous waste so long as it passes through a portion of the City's sewer system, commingled with domestic sewage, on its way to the POTW for treatment. This simply means that the Four County leachate is excluded from RCRA so long as it is introduced to the sewer system before it reaches the POTW.

The approach outlined above is thoroughly consistent with U.S. EPA policy regarding discharges to POTWs. EPA's CERCLA Site Discharges to POTWs Guidance Manual (August 1990) (hereafter "Guidance Manual") opposes only the application of the domestic sewage exclusion in a way that would allow RCRA hazardous wastes to be introduced to the sewers without adherence to RCRA manifest requirements in an uncontrolled fashion. Guidance Manual at 3-1. As outlined herein, the City's POTW will adhere to manifest requirements and will enforce its pretreatment regulations. Certainly, nothing in the plain language of the domestic sewage exclusion prohibits the acceptance of the Four County leachate into the sewers. Both legally and as a matter of policy, the proposal outlined herein is valid.

As a practical matter, the acceptance of Four County leachate into the City's sewer system poses no environmental threat. As noted above, the City will adhere to RCRA manifest requirements and will enforce its pretreatment regulations, so that the POTW will be able to monitor the leachate it is receiving and reject shipments that fail to meet pretreatment standards. The POTW has an outstanding track record, having received several awards in the field of water pollution control, including U.S. EPA's Award of Excellence in 1984 and 1986. The POTW will satisfy EPA's criteria for evaluating the feasibility of discharging CERCLA wastewater to a POTW. Guidance Manual at ES-1. In fact, the City POTW has already received and treated waste pickle liquor from the Continental Steel Corporation Federal Superfund Site pursuant to the domestic sewage exclusion.[1]

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[1] Analyses of the Continental Steel Site discharge are contained in the enclosed binder and were provided to the Indiana Department of Environmental Management. The binder contains other documents that support the conclusion that the City POTW is an appropriate treatment facility for the Four County leachate.

For these reasons, disposal of leachate from the Four County Landfill at the City of Kokomo's POTW is legal, practical and should be allowed. Please call if you have any further questions.

Sincerely,

Lawrence A. Vanore

LAV/rb
Enclosure

cc: Mr. Wayde Hartwick, Region V, U.S. EPA
Jeffrey Fort, Esq.
Frank J. Deveau, Esq.
Mr. John Tweddale, ERM